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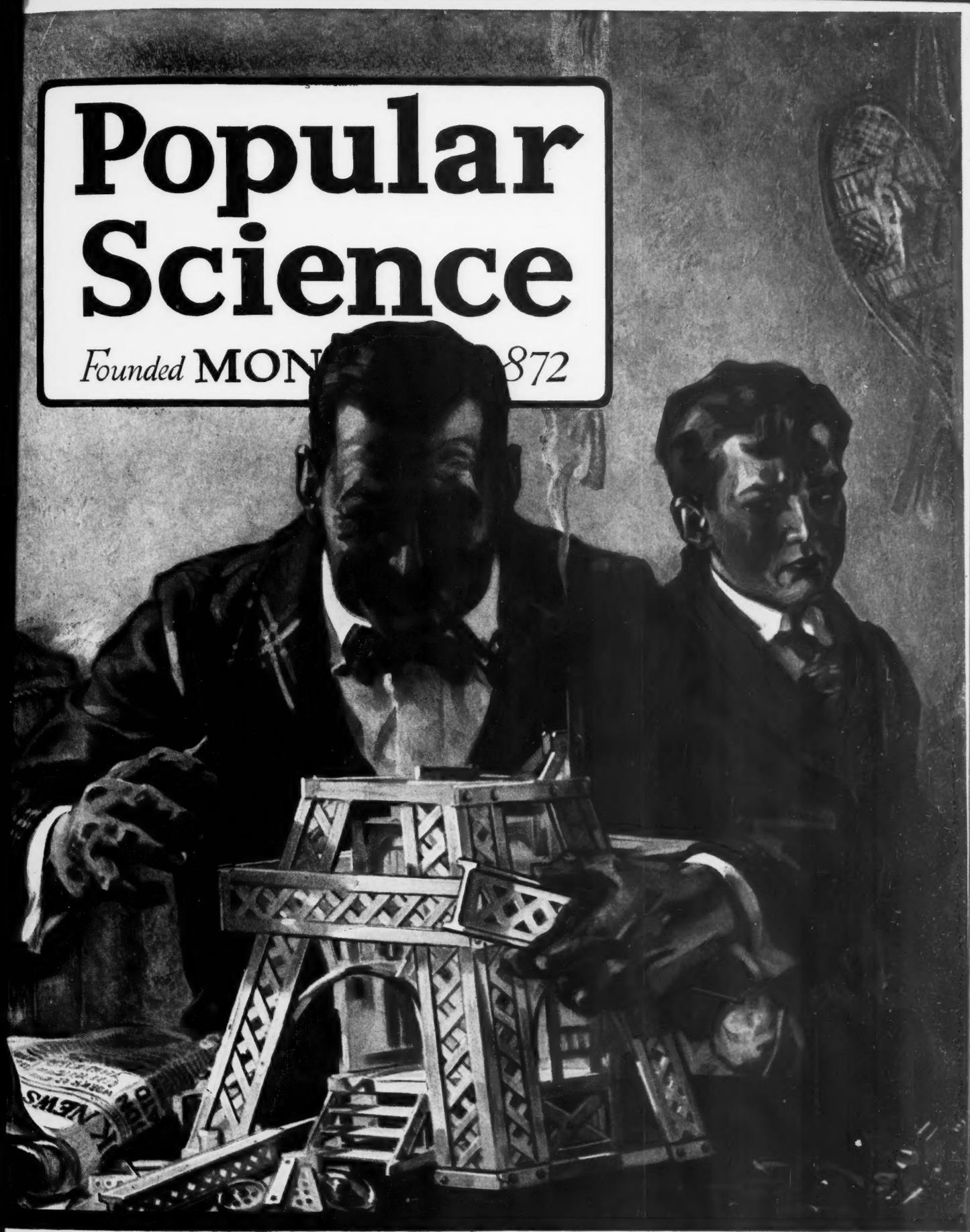

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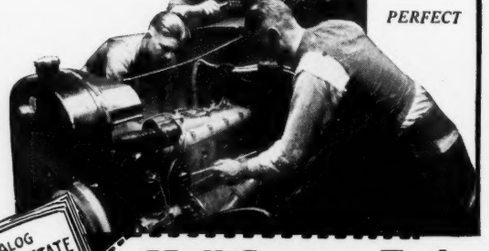

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Popular Science Monthly

January, 1922; Vol. 100, No. 1
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Motor-Ship Brings Us New Prosperity at Sea

Experts Claim Use of Diesel Engines Will Convert America's Idle Freighters into Profit-Payers

By Charles Frederick Carter

EVERY reader's pocketbook is skimpier than it ought to be, because of the huge losses incurred monthly by the Shipping Board in operating our emergency fleet. Every reader is bound to be interested, therefore, in this article telling how, in the opinion of many experts, we might convert our shipping losses into profits and, incidentally, realize our dream of making America the Merchant Queen of the Sea.—*The Editor*.

IS history, as wrought out in the life and works of the automobile, to repeat itself in the case of the motor-ship?

Will America soon lead the world in motor-ship building and operation? You may recall that the first few chapters of automobile history were far from flattering to American enterprise. For several years we just stood with mouths agape watching European manufacturers helping themselves to all the motor-car business in sight. But when we did come out of our trance, we swept the board.

Sea Supremacy at Stake

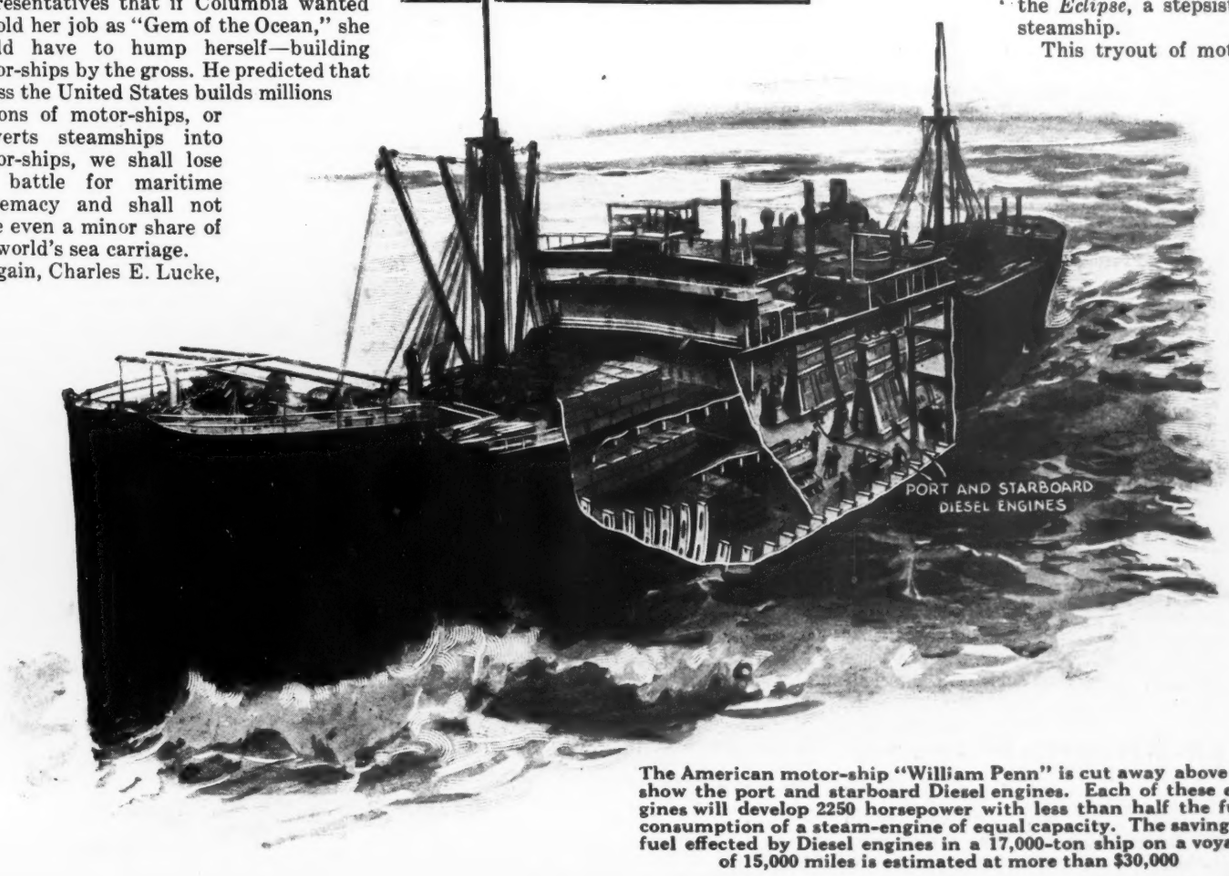
In the matter of the motor-ship we have surpassed the remarkable record for apathy and incapacity established at the beginning of the automobile industry. Just a few weeks ago William Denman, former president of the Emergency Fleet Corporation, told a select committee of the House of Representatives that if Columbia wanted to hold her job as "Gem of the Ocean," she would have to hump herself—building motor-ships by the gross. He predicted that unless the United States builds millions of tons of motor-ships, or converts steamships into motor-ships, we shall lose the battle for maritime supremacy and shall not have even a minor share of the world's sea carriage.

Again, Charles E. Lucke, professor of mechanical engineering at Columbia University, New York City, recently told a gathering of engineers and naval architects that it has "taken some years to convince American shipping interests that the motor-ship is reliable; that America can build satisfactory engines without copying European models; and that American shipping interests have now reached the point of accepting the situation." Professor Lucke also predicted that American motor-ship construction and operation will soon lead the world.

Shipping Board Has One Motor-Ship

The United States Shipping Board's first and only motor-ship, the *William Penn*, completed after three years' delay, was in New York not long ago, loading for a voyage to the Far East—a voyage to compare the *Penn's* performance with that of the *Eclipse*, a stepsister steamship.

This tryout of motor



The American motor-ship "William Penn" is cut away above to show the port and starboard Diesel engines. Each of these engines will develop 2250 horsepower with less than half the fuel consumption of a steam-engine of equal capacity. The saving in fuel effected by Diesel engines in a 17,000-ton ship on a voyage of 15,000 miles is estimated at more than $30,000

versus steam seems somewhat like a demonstration of the well-known fact that two plus two equals four; for before it began, thousands of steamships were tied up in the harbors of the world for lack of cargoes at living rates, whereas only one motor-ship was idle because of inability to get a cargo at a profit. Other motor-ships, constituting 1.7 per cent of the world's tonnage, were busy as the proverbial nailer earning dividends for their owners, while the steamships still in service found it hard to come out even, to say nothing of earning dividends.

Still, if *William Penn* wants to humiliate its stepsister by a demonstration of superiority, there can be no valid objection. It is no more than an elaboration of the results of the trial trip when the *William Penn* made a mile an hour better speed than the *Eclipse* on 300 per cent less fuel consumption. Bearing in mind that the cost of fuel constitutes 43 per cent of the expense of operating a ship, it will be seen that this was no mean feat.

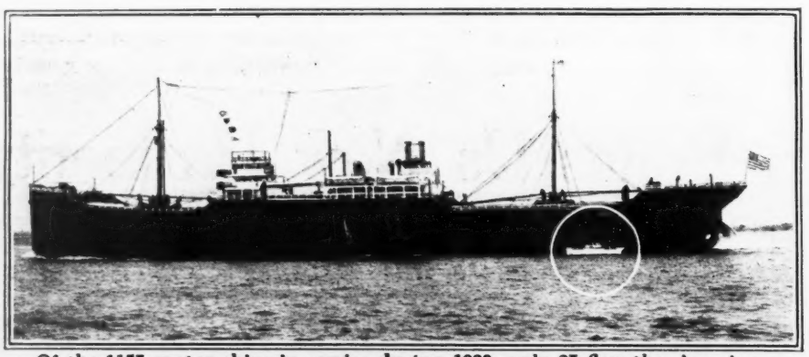
The prodigy which accomplished this is 455 feet long, 60 feet beam, 36 feet 8 inches deep, with a displacement, loaded, of 17,100 tons. Her two main Diesel engines, driving twin screws, have four cylinders with bores of 29½ inches and a stroke of 45¼ inches. At 115 revolutions a minute they develop 4500 horsepower. The bronze propellers are 13 feet 6 inches in diameter. Just to show how easily an American motor-ship can be handled, the *William Penn's* engines were reversed from full speed ahead to full speed astern in thirty-two seconds.

There are three Diesel auxiliary engines, each of 100 horsepower. Only one of these is needed at sea, but in port two are in use for handling cargo and other little chores. The engine-room crew consists of fourteen men. All the machinery below decks was built in Copenhagen. The only American machinery is the ten 30-horsepower Westinghouse motors driving the cargo winches.

Comparisons Are Startling

The *William Penn* made 12.6 knots on its trial trip as compared with speeds of 7.7 to 10.8 knots by six stepsister steamships from the same shipyard. When it comes to earning capacity, the comparison is still more startling. It has been calculated that a motor-ship of the size of the *William Penn* can earn 66 per cent more on dead weight capacity, or 55 per cent more when carrying bulk cargo than a steamship of the same size. Under conditions enabling the steamship to earn 11.2 per cent a year, a motor-ship of the same size would earn 17.4 per cent. Translated into dollars, this means that where a steamship would be able to earn $218,500 net in a year, a motor-ship would earn a net profit of $374,000.

At sea the steamship would burn 35.65 tons of oil a day; the motor-ship would need but 14.95 tons. In port the steamer would burn 5.5 tons of oil a day, while the motor-ship would do well with only .7 of a ton a day. For a voyage of 15,500 miles the cost of fuel for a steamship the size of the *William Penn* would be $45,900, while the *Penn* would need but $15,260 worth. Extended to the 2536 steamships of 12,797,000 tons now burning oil under their boilers, the waste of the world's rapidly diminishing supply of oil, as compared with the potential saving attainable by substituting motor-ships of equal tonnage, becomes appalling.



Of the 1157 motor-ships in service during 1920, only 27 flew the American flag. The boat in the circle represents America's motor-ship tonnage, as compared with the world's tonnage represented by the big ship. In the first six months of 1921, 321 motor-ships were added and America's share rose to 12%

But the light is dawning at last on the shipping world. Lloyd's *Register* recently reported that 194 motor-ships of 503,844 gross tons were building. Steamships, no longer profitable, are being converted into motor-ships that promptly become revenue producers.

A typical case is the Swedish steamship *Augusta*, which failed to earn profits until she was refitted with a Diesel engine.

When it comes to new construction, the motor-ship is virtually the only kind of craft considered abroad. A large number of orders for steamships have been cancelled in the last few months, but no orders for motor-ships have been countermanded. The big builders are spending millions to increase the capacity of their shops to turn out Diesel engines.

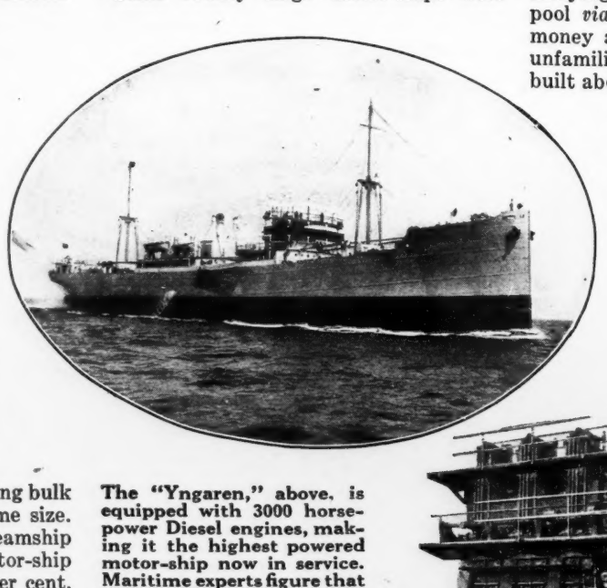
Some twenty large motor-ships were completed in European yards in 1920. Standardized craft of 15,000 tons capacity and 14 knots speed are normal and regular products, costing less a net ton cargo capacity than steamers. No fewer than twelve of the leading British shipowners are having motor-ships ranging up to 14,000 tons built, while still larger vessels are under consideration. The same tendency is noted in Continental countries. As for Germany, the fact that the existing fleet of steamers had to be surrendered to the Allies may be the determining factor of restoring the flag to the sea. Unencumbered by unprofitable steamships, the Germans are constructing Diesel-driven ships with great energy. One new yard with 19 ways is devoted exclusively to this type of construction, and the older yards are devoting particular attention to motor-ships.

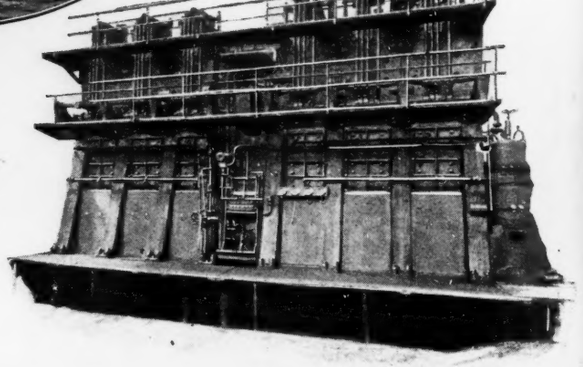
And America? Well, it begins to look as if Professor Lucke would prove a good prophet. At last reports nineteen motor-ships of 143,850 tons dead weight capacity and 44,520-shaft horsepower were building in American yards. The biggest single order was for four ore-carriers of 20,000 tons dead weight capacity and 11½ knots speed. In addition, a dozen or more steamships were being converted into motor-ships. No fewer than sixteen firms are building Diesel engines, while 120 others either have licenses for building Diesel engines of European design or are experimenting with original designs.

Why American Ships Lie Idle

The Pacific Coast is taking particular notice that while American steamers are lying idle there, foreign motor-ships are carrying wheat from Vancouver to Liverpool *via* the Panama Canal and making money at it. The Pacific people are not unfamiliar with the motor-ship, for they built about eighty of them during the war. Most of them, however, were underpowered wooden auxiliary craft, unsuitable for ordinary commercial purposes. Several full-powered wooden motor-ships gave splendid service and are still in regular operation.

Altogether it would appear that in the future the motor-ship will rule the waves.





The "Yngaren," above, is equipped with 3000 horsepower Diesel engines, making it the highest powered motor-ship now in service. Maritime experts figure that with such vessels freight can be transported 60 per cent cheaper than by steam-engine-driven ships. At the right is a Diesel engine of the type installed in motor-ships

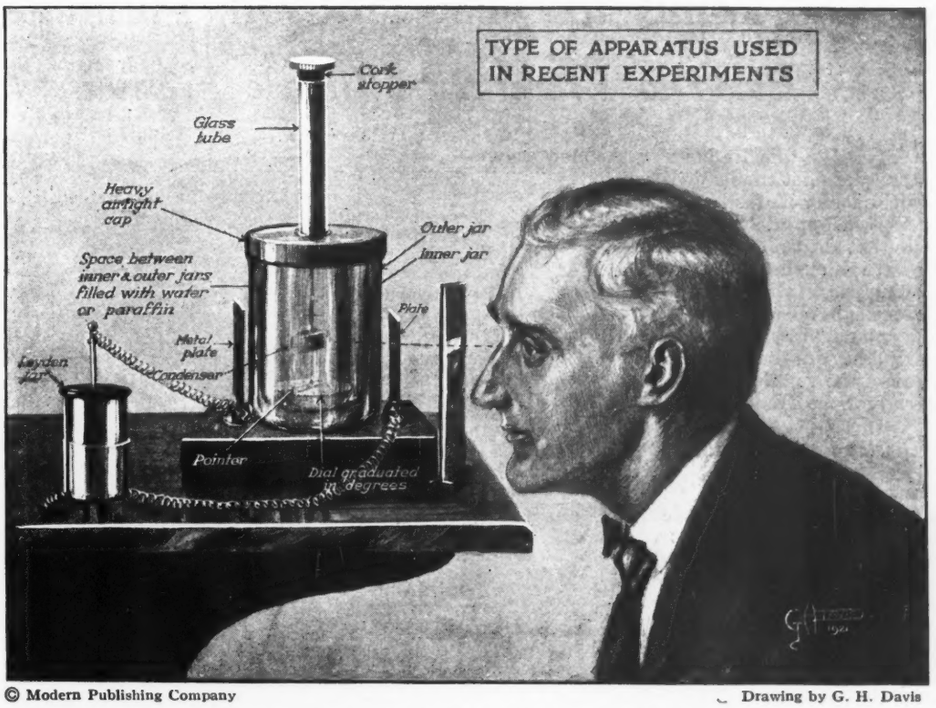
Mysterious Rays from Human Eye Move Solenoid

WILL science soon reveal the nature of a mysterious power of the human eye more amazing than sight itself?

Probably every one has experienced an almost intolerable sensation under the prolonged stare of another person's eyes. If one person looks into another person's eyes, one of them must at last avert his gaze.

Dr. Charles Russ, an eminent British bacteriologist, has constructed a device which he believes conclusively proves that the human eye possesses an invisible energy, powerful enough to move objects.

A delicate solenoid of fine copper wire wound on a celluloid cylinder is suspended from an unspun silk fiber fourteen inches long. The upper end of the silk is attached to a cork placed in the end of a long glass tube and the lower end is fastened in a metal yoke near a small electromagnet. The object is to bring the solenoid to rest after it has been set in motion.



© Modern Publishing Company Drawing by G. H. Davis

Dr. Russ's apparatus consists of a double glass jar containing a solenoid that is free to turn when the vision is directed through the slit

The entire system is enclosed in a double glass jar, covered with metal leaf. The space between the jars is filled with water or paraffin lest the bodily heat of the experimenter should influence the result.

On each side of the vessel the metal coating is scraped from one small spot. These openings are faced by insulated metal plates connected with a Leyden jar, which places an electrical potential across the air space inside the double vessel. Another opening is made for the eye.

If the experimenter looks at one end of the solenoid as soon as the plates are charged, it will turn away from him, says Dr. Russ. If he looks at the other end, that end will move away. No motion results if the eyes rest on the center. To enable the observer to more easily watch the effect, a pointer hung from the solenoid moves over a dial graduated in degrees.

Dr. Russ believes there is a ray of force propelled from the eye in the act of vision, which produces a tiny electric charge on the swinging solenoid. Of the nature of this energy he is not certain, although, since no effect is obtained in the dark, he thinks that the "emanation" is a refraction or a concentration of some unknown ray in light.

Newest Armored Battle Plane Carries Thirty Machine Guns

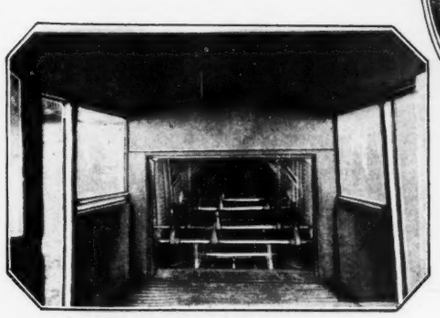
CARRYING thirty machine guns, and with its crew of three aviators protected by three-sixteenth-inch steel armor strong enough to deflect rifle and machine-gun bullets, a formidable military airplane was recently demonstrated before officers of the United States Army. Like the tank it is designed to attack infantry.

The plane was built by John M. Larsen on Central Point, Long Island, and is called the J-L attack plane. It is constructed throughout of American-made duralumin, the light, tough aluminum alloy, and is a monoplane with cantilever wings that require no external bracing. Its wing spread is 49 feet; length over all, 32 feet. The cruising speed is about 140 miles an hour, and its radius of action 400 miles. The plane is driven by a Liberty motor.

Larsen declares that the plane can be maneuvered as readily as the single-seater combat machine and can be put through such stunts as the Immelmann turn, though it weighs five thousand pounds when fully equipped.

The armament is arranged in two sections. Twelve machine guns are immediately behind the pilot's seat, and sixteen more are mounted in the tail of the fuselage. The remaining two guns are mounted and fired independently from the forward part of the cockpit, either by the pilot or the gunner. The main batteries are fired by means of three levers, two of which fire a section at a time. The third, the master lever, fires all twenty-eight guns at once. As each gun can fire fifteen hundred shots a minute, the plane is able to spray more than forty thousand shots a minute into a body of infantry caught in the open.

The armored J-L attack plane, of all-metal construction, has a cruising speed of 140 miles an hour. Its radius of action is 400 miles. Twelve machine guns are immediately behind the pilot's seat, sixteen are mounted in the tail of the fuselage, and two on the forward part of the cockpit



The interior, looking rearward, where sixteen of the guns are mounted

With three levers pilot and gunner control twenty-eight guns

Drivers Motor for Hours through Poisonous Gas in Old Mine to Test Hudson Tunnel Ventilation

Give Blood to Prove Air Will Be Fresh in Two-Mile Tube

ENGINEERS who are building the nine thousand-foot tunnel driveway for vehicles under the Hudson River between New York City and New Jersey want to be sure that the tube will be supplied with enough fresh air, and accordingly in an abandoned coal-mine, one hundred and thirty feet below ground, at Bruceton, Pennsylvania, they are testing a reproduction of the ventilating system designed for the Hudson project.

Effects of Gases Studied

The effects of automobile exhaust gases on the human system are being studied by means of medical examination of drivers who are actually running cars in a miniature tunnel, in which have been reproduced conditions that will be met in the larger project.

The experimental tunnel is shaped like an oval race-track four hundred feet in diameter. The cross section is nine feet wide and eight feet high. Along the ceiling is an air-duct three feet high, and below the floor is another duct two and a half feet high. In proportion to the length of the tunnel, these dimensions are in the exact scale of the driveway under the Hudson.

Hour after hour, ten small automobiles, spaced forty feet apart, circle the track at a speed of ten miles an hour. Sometimes the gas mixture is deliberately enriched until each car is emitting clouds of smoke; at other times a correct mixture is used. The tests continue until the engineers are sure that the ventilation will be sufficient to supply enough fresh air, no matter how careless drivers may be.

The amount of carbon monoxide absorbed by drivers is determined by examination of their blood immediately after the tests

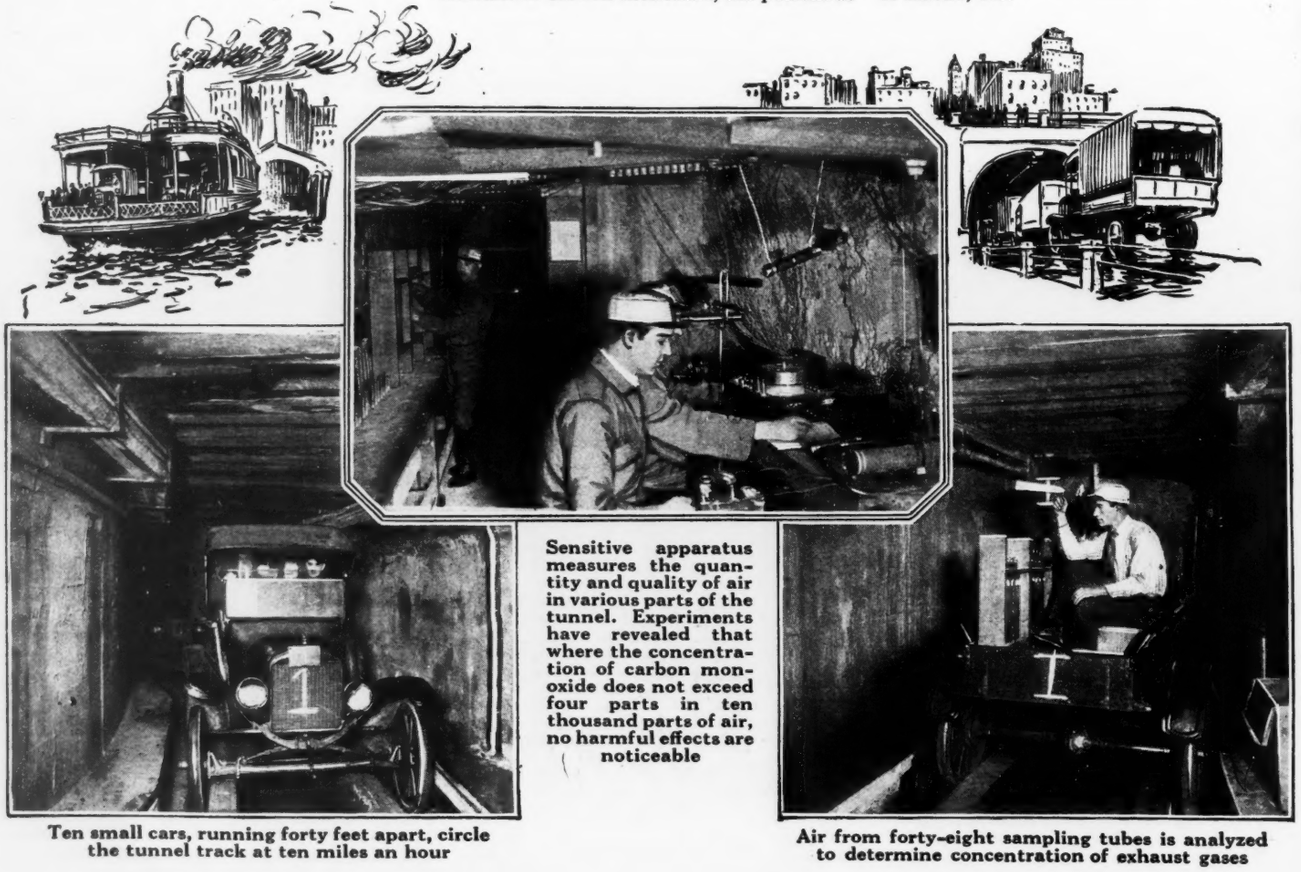
Exhaustive tests have revealed that the amount of carbon monoxide, the poisonous constituent of exhaust gases, averages about 7 per cent of the total volume, and that the health of drivers using an enclosed tunnel requires that the proportion of the poison in the air be reduced to less than four parts in ten thousand. To maintain this percentage, 2100 cubic feet of fresh air is pumped into the experimental tunnel every minute.

During the tests sensitive instruments in all parts of the tunnel analyze the air to determine its temperature, humidity, velocity, and pressure, as well as concentration of gases emitted by the moving cars. Forty-eight air-sampling tubes obtain samples for chemical analysis.

Drivers Give Their Blood

Each driver is examined, before and after his run, by physicians and experts of the Bureau of Mines, who specialize in the effect of poisonous gases on the human system. The amount of carbon monoxide absorbed by a driver is determined by testing a few drops of his blood.

The results of these tests will provide a basis for ventilating systems in proposed vehicular tunnels in other parts of the United States. In order to be sure that the means finally adopted will make vehicular tunnels safe under every condition, the engineers have abused the system, reducing the flow of air, increasing the amount of smoke, etc.



Ten small cars, running forty feet apart, circle the tunnel track at ten miles an hour

Sensitive apparatus measures the quantity and quality of air in various parts of the tunnel. Experiments have revealed that where the concentration of carbon monoxide does not exceed four parts in ten thousand parts of air, no harmful effects are noticeable

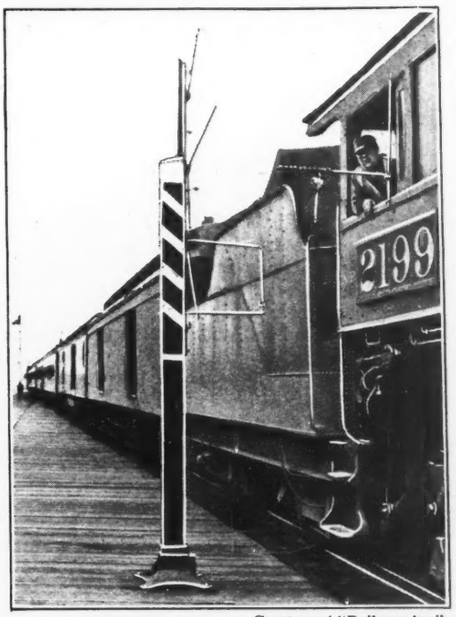
Air from forty-eight sampling tubes is analyzed to determine concentration of exhaust gases

Mechanical Arms Deliver Orders as Trains Pass

MECHANICAL railroad order-deliverers installed along seventy-eight miles of the Idaho division of the Northern Pacific are proving to be time-savers by replacing the old hoop system of delivery. Trains no longer need to slow down to pick up orders.

The deliverer is a thirteen-foot post equipped with a movable carrier with three pairs of arms, between which the train orders are fastened on a rope. These arms are at three levels and, when necessary, can deliver three copies of an order to a train. In double heading, for example, a large engine can pick up its order from a twelve-foot level, a smaller engine can use a ten-foot level, while the train-crew uses the eight-foot height.

The top arm of each pair is fitted with a spring so that it flies up against the post as soon as the order is taken, while the lower arm drops by gravity. When an order is placed, the carrier is lowered and a two-foot piece of cord with a spring clip on each end is fastened over the hooks of the carrier arms. The carrier is then raised to the proper height. The order is in a waterproof canvas bag attached to the center of the cord.



Courtesy of "Railway Age"

Arms extending at three different heights from a post beside the railroad track hold canvas bags containing orders that are caught as the train passes

The catcher on the locomotive consists of a steel rod, to which is riveted a flat piece of steel shaped in the form of a number of inverted V's, the points projecting outward and forward. A V-shaped spring in front of these points prevents the rope holding an order from dropping out after having once entered the space between the teeth. In actual operation, the impact of the bar moving at thirty miles an hour wraps the rope around the catcher so tightly that dropping orders is almost unknown. Besides saving time, the device prevents accidents to trainmen.

FIFTY-ONE million tons of almost pure iron, in the form of loose blocks ready for the smelter, have been discovered in the Lake Athabasca region.

Invalids Can Travel Far in Electric Chair

IN this electrical invalid chair the patient may obtain fresh air, if not exercise. A small electric motor installed beneath the seat will drive the chair for several miles, on one charging of the storage battery. Springs on all wheels are sufficiently flexible to cushion any unevenness of the road or pathways over which the chair travels.

The invalid may ride as comfortably as if he were in an automobile

USE of aluminum as a substitute for copper during the war has led to greatly increased production throughout the world. The output has risen more than 100 per cent since 1914.

One hundred and ninety-three thousand tons of metal was refined in 1920, with the United States leading production by seventy-three thousand tons.

Popular Science Monthly Gives Lectures by Radio

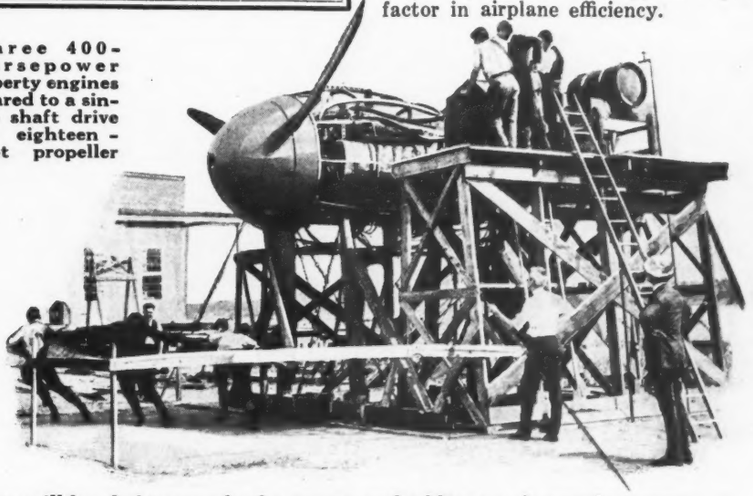
AT the request of the Westinghouse Electric & Manufacturing Company, which is inaugurating a radiophone service from its plant at Newark, New Jersey, POPULAR SCIENCE MONTHLY, once every four or five weeks, is supplying entertainment in the form of talks by the editor on developments in the scientific world. These wireless lectures are heard over a radius of 600 to 1000 miles. They are part of a big nightly program of broadcasted news, musical features, and speeches.

Three Liberties Geared to One Propeller

THREE four-hundred-horsepower Liberty engines geared to a single eighteen-foot propeller make up the new power unit that may assure non-stop flights from New York to Liverpool in twenty hours. The unit was put through careful tests recently at the Gallaudet shops in Warwick, Connecticut.

It is expected that airplanes with three or more of these units, with a total of four thousand horsepower, will have a non-stop cruising radius sufficient to cross the Atlantic carrying twelve tons of passengers or freight.

The safety of flight is increased by gearing three engines to one shaft, since a failure of any one engine will not necessitate a forced landing. While the speed of the plane will be reduced, it will still be able to proceed. The use of the larger propeller simplifies design and reduces propeller slip, which is, needless to say, an important factor in airplane efficiency.



Three 400-horsepower Liberty engines geared to a single shaft drive an eighteen-foot propeller

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Planes without Engines Climb the Air Like Birds

Using Movements of the Wind, German Gliders Soar for Miles without Power and Add New Chapter to Romance of Aviation

By Stanley Yale Beach, Ph.B.

CAN we fly without engines?

Less than a year ago Popular Science Monthly put this question, and answered it by showing what had been done along this line in Germany. The conclusion reached at that time was that, "although we cannot yet sail like the albatross for hours on end, we can cover very respectable distances by gliding from an elevated point."

Since then, the second annual gliding competition has been held in Germany under the auspices of the Scientific Society for Aeronautics, and the results have been so remarkable that we shall have to modify the first part of the conclusion to read: "Man has already sailed like the albatross and has circled, as does the buzzard, *over one third of an hour at a stretch.*" For these enthusiastic German experimenters have gone far beyond the gliding performances of Lilienthal and other pioneers and have achieved a very spectacularly different thing—true soaring flight. Gliding, as every one knows, is simply descending under the influence of gravity on a gentle gradient, and often with the assistance of slightly rising currents of air. Soaring, on the other hand, is true flight without power; it takes advantage of pulsations and other movements of the wind to obtain not only horizontal motion but actual climb as on an invisible staircase.

A Spur to Progress

This return to first principles was occasioned in Germany by the terms of the Treaty of Versailles which limited the Germans to 150 regular motor-driven machines to be used on commercial air lines. In attempting to clip Germany's wings, the Allies have been the means of promoting scientific progress in aviation that probably never would have been accomplished otherwise.

About a dozen competitors entered the first competition held in August and September, 1920, and only one noteworthy record flight was made. So great was the interest, however, that last fall over two score contestants participated and broke records many times over.

The outstanding figure in both competitions was Engineer Klemperer with his motorless monoplane called the "Black Devil." It is constructed along the lines of the Junkers' cantilever monoplane, but of light plywood instead of duralumin. It has a spread of thirty feet and, with 172 square feet of supporting surface, weighs 125 pounds.

The scene of the two contests was the Wasserkuppe, a mountain three thousand feet high in the Rhön district of Germany, Starting from the slope of this mountain, Herr Klemperer last year made a duration record of two minutes and twenty-two and three fifth seconds, during which he flew 1830 meters (6004 feet). In the contest this year he more than doubled his duration record by a flight of five minutes and thirty-two seconds. Koller, on the Bavarian Aero Club's monoplane, this year made the distance record of 4200 meters (2.6 miles) measured in a straight line, though he actually traveled more than this, since he described circles in the course of his flight.

Immediately after the competition had ended, Herr Klemperer made the most amazing flight of all. No sooner had the monoplane moved a couple of yards, than it rose vertically some thirty feet and kept on rising in a series of steps until, three minutes later, it reached a height of four hundred feet above its starting-point! All the while it was sailing along against the wind, its skilful pilot causing it to circle and describe figure eights. It flew over several villages, wherever Herr Klemperer directed it, exactly as if propelled by a motor, and thirteen minutes after the start, it alighted at Gersfeld after a long volplane.

Herr Klemperer, with his motorless monoplane, rode the air for thirteen minutes, soaring from the slope of the Wasserkuppe to the village of Gersfeld, a distance of four and one quarter miles in a straight line. The actual path of the flight covered a distance of six miles

Six Miles without Power

The flight path followed covered a distance of six miles, although in a straight line it was but four and one quarter miles. For ten minutes it kept the same level. This demonstration of how one can ride the waves and billows of air exactly as do the soaring birds was received with great enthusiasm throughout the scientific world, where it was realized that man's dream of the ages had actually come to pass.

Herr Klemperer's monoplane was not provided with landing-wheels, it may be remarked here, but like the other soaring machines entered in the competitions, took off from, and landed on, simple wooden skids. A typical way of taking off is by means of a rope, to which are attached long lengths of elastic. Passed around the undercarriage of the machine, the rope is grasped at each end by three or four assistants, while two others hold the wing tips of the machine. The men at the ends of the rope then walk down the slope, and so stretch the elastic. At the word "Go" from the pilot, the men at the wing tips release the machine, and it darts forward like an arrow shot from a bow.

Klemperer's Record Beaten

Within a week after Herr Klemperer had made his amazing flight, his record was thrice beaten. Herr Martins, on the Hannover (Proll) monoplane glider, remained aloft 15 minutes, 40 seconds, covering a distance of 7200 meters (four and one half miles), and finally landing near Batten after a 1300-foot volplane. He maintained his level, or rose above it, for eleven and one half minutes. Herr Harth, on his monoplane, soon increased the time in the air to twenty-one minutes, during which he dropped but forty feet below the starting-point. He added one more minute to his duration record the next day, making a flight that lasted twenty-two minutes. These marvelous flights will undoubtedly be increased until, with the use of a small motor to help out when the air waves diminish, man will be able to soar hour after hour.

At Kitty Hawk, in 1912, Orville Wright rose vertically from the ground in one of his biplanes without a motor. He did this by facing a gale and was able to hover over one spot for ten minutes, during which time he frequently advanced as far as he liked in the teeth of the wind, then allowed his glider to be forced back again. Thus it is clear that the powerful motors of today are really unnecessary when we come to ride the air waves as the Germans are doing. Luckily, several of our active clubs of young men, such as the Aero Science Club of America, the Pacific Coast Aero Club, and the Aero Club of Ithaca, have taken up this sport and science of gliding and soaring flight with a zest, and there is hope that our country will eventually lead in motorless flying just as we are striving to do with power flying.

There are many uses to which gliders can be put, such as to replace kite balloons in the navy, and to train aviators. Then, too, developments in radio transmission of power may yet make it possible to send through the air the small power required by a glider to keep going during lulls. It is even possible that radio power will propel as well as control, aircraft.

Gliders that Made History in the Rhön Contest

© Keystone View Company

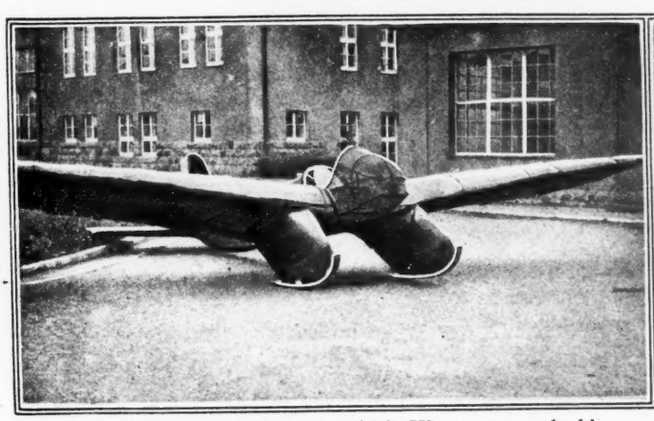
A departure from the orthodox design is represented in Neuenstein's triplane glider with its compact dimensions of only nine by twelve feet. In contrast with monoplanes, which are set in motion by huge rubber bands, this triplane is started by the operator, who speeds down a hillside until lifted from his feet by the air currents

Since the inception of the airplane some workers have maintained that the final successful heavier-than-air machine would follow closely the contour of birds. Karl Rath, one of the contestants at Rhön, entered the hawk-shaped plane shown above. The pilot sits between the wings, which are filled with air

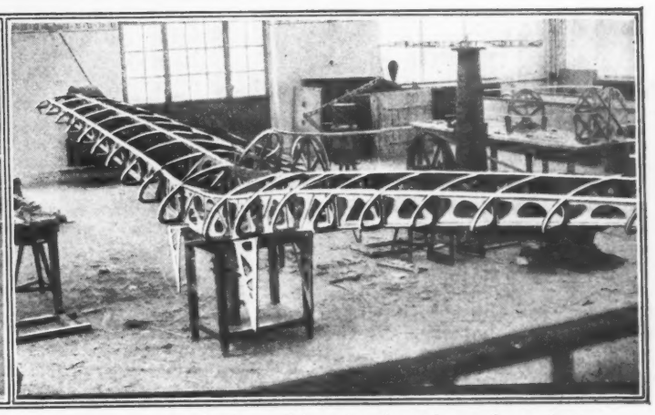
Shortly after the Rhön contest, Klemperer made a world's record flight in his Aachen monoplane during which he sailed over the surrounding country for thirteen minutes and covered six miles. At times he reached a height of three hundred feet and his glides were accomplished in the ratio of 1 to 19, meaning that he could travel nineteen feet horizontally for each foot dropped

Motorless flight, which, as the experiments illustrated on this page show, has been developed to an extraordinary degree in Germany, is still virtually neglected in this country. Only about a score of Americans are engaged in similar activities. POPULAR SCIENCE MONTHLY will be glad to hear from any readers who have undertaken experiments with gliders

At the left Klemperer is shown in his record-breaking flight as he soared up and down, to one side and then to the other, and even cut figure eights, to the wonder of the peasants toiling in the fields below



The Aachen monoplane, in which Klemperer made his record flight, is distinguished by the "trousered" under carriage and the curved landing-skids. Klemperer made fifteen successful flights in this machine



Frame of the Aachen glider, showing plywood construction, wide dihedral angle of the very thick wings, and the struts supporting the landing-skids. These planes are noteworthy for their excellent gliding angle

What Do You Want to Know ?

Let Popular Science Monthly Answer Your Problems

Learn the Answers to Other Readers' Questions and Ask Your Own

Why can you put your finger on the bottom of a steaming teakettle without being burned?—H. T.

Because the heat of the fire has been transferred from the kettle bottom to the water which is boiling and forming steam. It is for the same reason that kettles with soldered bottoms, and containing water, can be safely placed over a fire. The greed of the water for the heat carries it away so rapidly that the temperature of the metal is unable to rise high enough to melt the solder.

??????????

Which type of water-wheel has the highest efficiency, the overshot, undershot, or turbine?—F. D. M.

The turbine type of water-wheel has the highest efficiency, ranging from 75 per cent to 85 per cent. Next comes the overshot wheel, with an average efficiency of 70 per cent, and finally the undershot wheel, with an efficiency of about 60 per cent.

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What are the usual porcelain electrical insulators made of ?—J. D.

The materials used are kaolin, china clay, ball clay, feldspar, and silica.

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What is bakelite?—J. W. J.

The condensation product of phenol and formaldehyde, that forms a definite chemical compound. Its manufacture is protected by a number of patents.

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How can muslin, to be used for a hot-air balloon, be made airproof?—E. R. D.

Make a very thin solution of pure rubber in carbon disulphide. Apply the dissolved rubber with a brush. Carbon disulphide is inflammable and should be used with care.

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Do you know of a stove enamel that will not burn off?—H. M.

Try an enamel composed of one part of silicate and two parts of water, using finely powdered graphite as a coloring medium. The mixture must be thoroughly worked together, and should be first tried on a small area of the stove.

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Please tell me the solution used in an Edison-Lalande battery.—D. C.

The solution is one part of caustic soda dissolved in three parts (by weight) of water. After emptying solution into the cell, it is covered with a layer of petroleum oil to prevent oxidation by air. Black oxide of copper is used as a depolarizer in the Lalande cell.

Why Is Ice Slippery?

R. E. L. Sends in This Question. Here's the Answer:

When you place your foot on the ice, the pressure melts a small area, and the layer of water thus formed acts as a lubricant. In the unusually low temperature of the Arctic regions, melting of the ice by foot pressure is much more difficult, and the tendency to slip is considerably lessened.

Every reasonable specific query in the field of general science addressed to this department will receive a prompt reply. Legal and medical queries cannot be answered.

A stamped self-addressed envelope must accompany each question.

Address the Editor, Popular Science Monthly, 225 West 39th Street, New York.

Can wood be artificially petrified?—S. L.

No, but it may be coated or impregnated with some silicate compound that will eventually harden and make the wood highly weatherproof.

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How can pictures from magazines or newspapers be transferred to plain white paper?—C. C. P.

Make a solution of 2 drams of pearlash, ½ oz. of soft soap, and 16 fluid oz. of distilled water. Apply the solution to the picture with a soft brush or sponge and allow to soak. Put clean sheet of paper on top of picture and another clean sheet of fairly thick paper on top of that. Rub over the top with the back of a spoon, remove the sheets, and the picture will be found transferred to the clean sheet.

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What is the temperature of liquid air, and what would happen if a gallon of it were released under water?—E. S.

Four hundred degrees below zero. The water would simply boil and change a certain amount of the surrounding water to ice.

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Can you inform me what causes spontaneous combustion in coal?—A. W. C.

When bituminous coal is exposed to the air, it slowly but surely absorbs the oxygen and just as slowly and surely does this oxidation cause a rise in temperature. The higher the temperature of the coal the quicker it eats up the oxygen, a process that increases in speed as it progresses, until soon the coal has reached a point at which it ignites and we have what is known as spontaneous combustion.

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I should like to know something about thermite welding.—B. M.

The thermite is placed in a specially prepared crucible of refractory material and the reaction started by means of an igniter. The fluid mass of iron produced is poured into a mold built around the joint to be welded. This process is especially useful for welding conductor rails, defective castings, and parts of broken machinery that must be repaired at the places where they are in use.

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Can you advise of some inexpensive way to restore the color to small pieces of burnished aluminum?—F. L. S.

Use water made slightly acid by a small amount of sulphuric acid, the amount to be determined by experiment. A dash of ammonia added to the water will also act as a cleansing reagent.

??????????

How can I waterproof muslin or other light cotton material?—R. D. B.

Coat the cloth with one or more applications of a thin colloidal rubber solution. It is better to give the material three thin coats than one thick coating. It should be understood that any cotton cloth loses its pliability and texture when waterproofed.

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Why is it necessary to strike safety matches on the box?—G. P. O.

The phosphorus used as the base of most matches is not in the head of the safety match, but on the box. This striking surface is red phosphorus and sand. The match head contains antimony sulphide, an oxidizer and glue. When the head is struck against the striking surface a minute amount of the surface is ignited, which in turn sets fire to the match head.

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When milk is churned, what makes the butter?—R. L.

Milk contains a large fat content consisting of tiny globules floating about independently of one another. When milk is churned, these particles of fat are consolidated into one mass that is called butter.

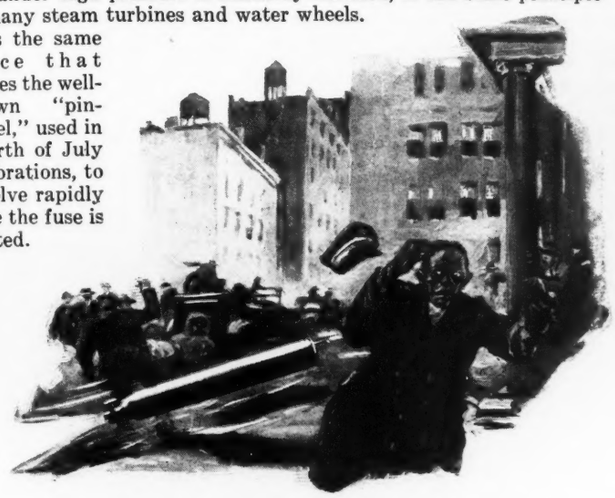
Runaway Gas-Tank Spreads Terror in St. Louis Street

WITH a hissing roar, followed by a cloud of whitish vapor, a carbonic-acid-gas container, over five feet in length and weighing nearly two hundred pounds, recently performed a series of wild somersaults along a busy street in St. Louis. It slid under an automobile standing at the curb and smashed a rear wheel as it rushed out. It gyrated wildly for two hundred feet down the street while pedestrians dodged into doorways and passing automobiles sped from the neighborhood.

People at first saw no cause for alarm when a carbonic-dioxide-gas container, such as is used in charging soda water, fell from a passing truck. But when it hit the pavement the cap broke and instantly the excitement began. The force with which the highly compressed gas escaped from the small nozzle of the container was sufficient to throw the iron tube about like a straw and it was a marvel that no one was hurt in the minute that elapsed before the tank gave a final gasp and stopped quietly in the gutter, its contents exhausted.

This same energy of reaction, always displayed when a liquid or gas under high pressure is suddenly released, is the basic principle of many steam turbines and water wheels.

It is the same force that causes the well-known "pin-wheel," used in Fourth of July celebrations, to revolve rapidly once the fuse is lighted.



Pedestrians fled as the hissing tank of carbonic-acid gas somersaulted along the pavement

When the ice barrier broke, a torrent carried great boulders down the mountainside

Glacial Dam Bursts, Flooding Alpine Valley

HOT weather and melting snow and ice in the Alps last summer resulted in a flood that strewed an Alpine valley with gigantic boulders and washed away roads and dwellings. Early warnings of the break prevented any loss of life.

As the sun melted the ice, a large body of water collected in a pocket on the Gruben glacier in the Bernese Oberland. For a time a barrier of ice acted as a dam, but eventually the pressure became too great. The ice split with a deafening crash. Rocks embedded in the ice for centuries were tossed high in the air, and a mammoth wave of water swept down the valley.

The force of the water carried away a large section of the terminal moraine. Boulders were carried down by the current and deposited on the Grimsel Road, one of the most important highways through that section of the Alps, to such a depth that traffic was impossible for days. The deluge was the first of its kind on record in the Alps or other mountain ranges.

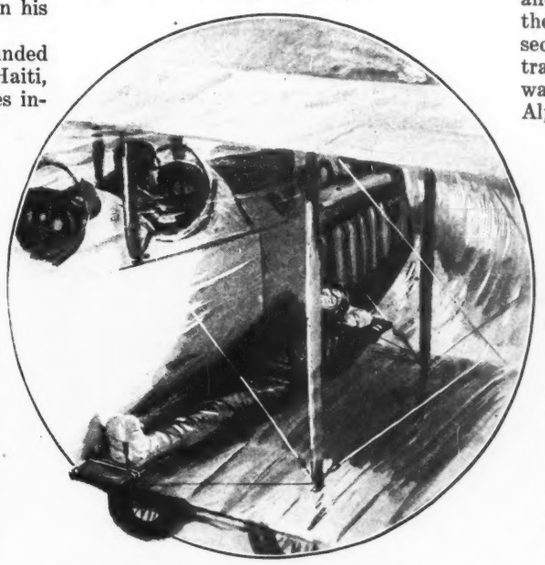
Injured Man Carried on Airplane Wing

IN the inland jungles of Haiti a man had been badly mangled in an accident. To save his life it was imperative to carry him to a hospital at once. Hours of jolting over the rough roads was unthinkable, so the physician telegraphed for an airplane, and soon Lieut. Kenneth B. Collings, of the Marine Corps, arrived at Maissade in his plane.

Transportation of the sick and wounded by air is a common occurrence in Haiti, where the roads are bad and at times infested by bandits. This case, however, was an unusual one. The man had been badly hurt. Both of his thighs were broken and he was in splints, so that it was impossible for him to sit in the cockpit, or even to be carried there. His condition was critical, and Lieutenant Collings decided to rush the journey with the patient strapped to the wing of his plane.

The man was bandaged to the eyes, covered by a blanket, and securely lashed to a six-foot plank. A helmet and goggles were slipped over his head, and he was placed on the lower wing, where he was tied by straps secured to the wing supports and the fuselage.

The weight on the wings made flying "rather difficult," comments the official report. It was nearly impossible to keep the plane balanced, and Collings had to be constantly "on the stick," that is, manipulating his controls, in order to make the trip safely. The patient was delivered at the hospital, however, within thirty-five minutes. Hours or days would have been required to make the trip over the rough Haitian roads.



The patient, on an improvised stretcher, was lashed to the wing supports and fuselage

Beetles Gnaw through Lead Phone Cables

A TINY beetle, smaller than a lady-bug, is causing much damage to telephone cables in California by gnawing tunnels through the protective lead covering of the cables. The rain-water penetrates to the wires enclosed in the lead tubing and causes short-circuits that interrupt the connections of many subscribers.

No effective method of combatting these destructive beetles has as yet been devised and the telephone companies have sent an urgent appeal for aid to the entomological bureau of the Department of Agriculture in Washington, D. C.

New De-Luxe Motor-Bus Brings High Speed and Greater Comfort to Interurban Travel

Twelve-Wheeled Sleeping-Cars May Run on Elevated Highways

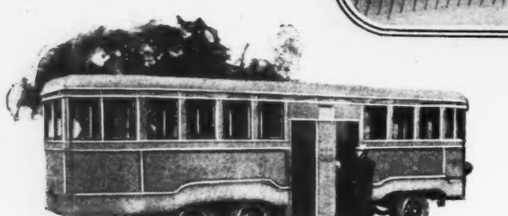
By Harold F. Blanchard

A LONG, steel motor-car, mounted on twelve pneumatic-tired wheels, flashes with express-train speed along elevated tracks of smooth concrete. As it glides in the darkness above farms and villages, passengers sleep soundly in comfortable berths. No racking jars, no swaying and creaking at sharp turns, no shrieks of whistles at grade-crossings, disturb their slumbers.

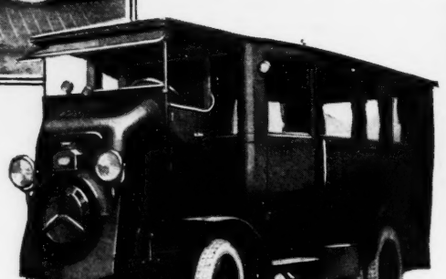
The car is the motor-bus Pullman express, making time on high-speed roads.

This is no fantastic creation of the imagination. The motor-bus Pullman is an innovation that mechanical genius is developing with astounding rapidity. Even now, buses that are marvels of mechanism and comfort are traveling the roads of America and Europe. Engineers are projecting plans for right-of-ways and concrete tracks, over which giants of the road, with six, eight and twelve wheels, will handle freight and passenger traffic. Before many years have passed, authorities agree, a vast network of these service lines will link the cities.

Extensive tours by Pullman auto-buses with a second car following to carry maids and valets and a certain amount of baggage have already been projected by farseeing firms in this country and Europe. Comfortable chairs inside and an observation platform atop the bus will provide all conveniences desired by the tourist



The six-wheel buses operated on regular schedule in Akron, Ohio, are forerunners of the twelve-wheel Pullman auto-bus



Luxurious buses, rivaling in their appointments the railway Pullman, are running on regular routes throughout England

As an intercity carrier, the motor-bus has reached its greatest development on the Pacific Coast. It is now possible to ride from Ensenada or Tia Juana or Mexicali, in old Mexico, to Portland, Oregon, a distance of a thousand miles as the crow flies, and in no other vehicle than the motor-bus. In southern California, again, is located the largest motor-stage line in the world, with 164 vehicles having a seating capacity of more than four thousand.

Buses Beat Train Schedules

The "motor-stage" companies issue time-tables that would do credit to any railroad, and Los Angeles boasts a terminal where passengers are picked up and discharged by five hundred buses daily and six hundred and fifty on holidays.

More than two million passengers were handled in 1920 by a single company in California. The president of this company says that the schedules maintained over the wonderful Pacific Coast roads frequently equal and sometimes exceed, the speeds made by the best railroad trains. This condition is partly due to the fact that the motor-bus, a better hill-climber than the railroad train, can take a more direct route through the mountainous country.

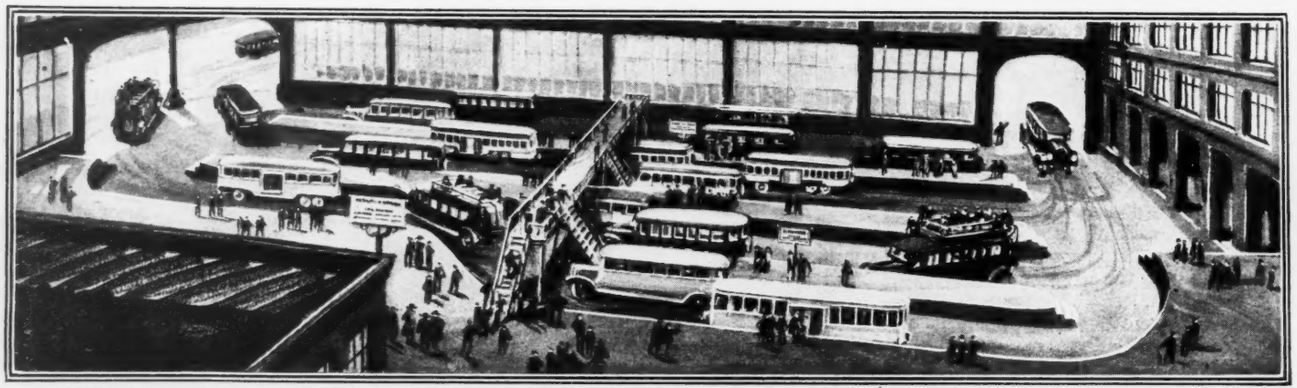
The same man goes on to say, incidentally, that his latest design, now in course of construction, will be a steel coach equipped with wireless telephone and with reclining chairs.

The motor-bus is appreciated on the coast because, also, it reaches many places inaccessible to other forms of transportation, and the breakdown of one unit does not tie up the whole line. Towns that were served by one or two trains a day now have hourly bus service.

A large majority of travelers now see the beauties of California from the motor-bus. It should be emphasized, however, that these great bus lines are operated primarily to provide adequate transportation for the cities in this territory and the sight-seeing feature is merely an incidental advantage.

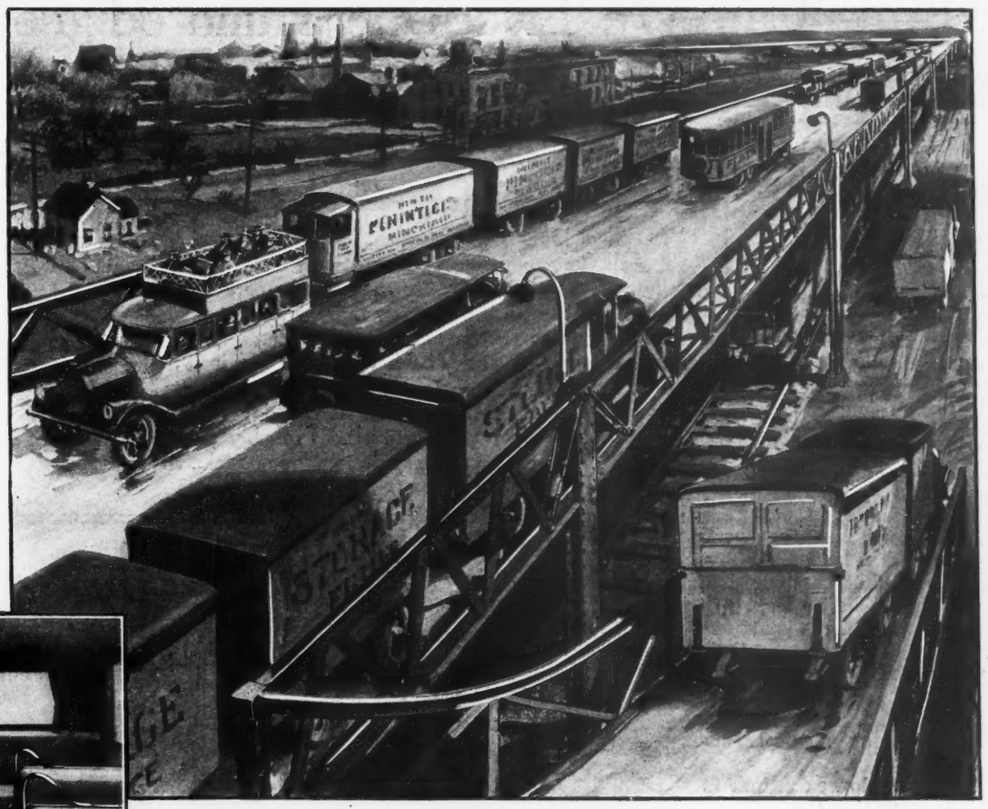
On the other hand, in England, France, and Switzerland, the sight-seeing motor-bus is a highly organized business.

In England, Pullman buses carrying fourteen passengers and capable of high speed, since they are shod with large pneumatic



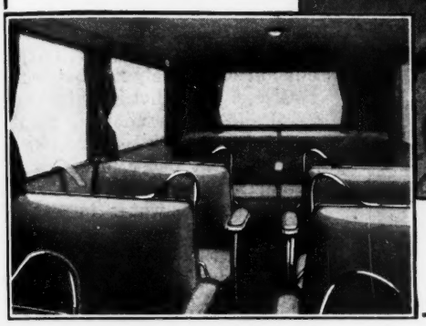
Motor-bus stations patterned after railway terminals with facilities for the loading of passengers and luggage have been laid out for the long-distance bus-lines of London. The station illustrated will accommodate twenty-eight buses

Cross-Country Rapid Transit by Pullman Bus in the Future



The future will see roadways constructed especially for bus traffic on elevated structures over railroad right-of-ways. Long-distance haulage will be accomplished by trucks drawing trains of trailers over the concrete roadway, and Pullman buses will provide rapid service between distant points

Below is another type of seating arrangement as worked out for Pullman buses. As the demand for auto-buses increases, it is expected that convertible sleeping-cars containing eight or more berths will be designed for use on the thousand-mile trips now planned



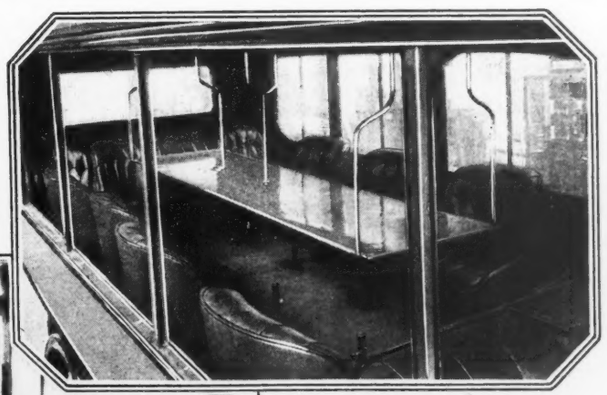
tires, are used for scheduled daily trips from London to the seashore and return, as well as for tours occupying several days. An interesting feature of this service is that special trucks are provided to carry baggage, of which each passenger is allowed fifty-six pounds free. In lieu of Pullman porters, a valet and lady's-maid accompany each baggage-van.

Sleeping-Car Buses Planned

One English company is now planning a terminal with four long "tracks," with raised platforms for loading and unloading passengers and baggage. Just as in the Los Angeles terminal, there will be waiting- and baggage-rooms, refreshment booths, ticket offices, in short, all the conveniences found in a railway terminal.

Another and impending development along the lines of railroad practice is the use of sleeping-car buses. These will be built more like the railroad type than present designs, and will probably be at least twenty-six feet over all, with three or four sections on each side. Each section will, of course, have two berths. At three cents a mile the income from such a bus will be forty-eight cents a mile, plus a charge of at least three dollars for the bed. If this bus ran only one hundred miles during the night, its income would be forty-eight dollars on the mileage basis, and forty-eight dollars more for sleeping accommodations.

But is there a place for the motor-bus Pullman? The answer is yes. Many cities in the country are linked by good roads, but not connected by direct sleeping-car service.



Two views of an auto-bus with Pullman swivel chairs. A table can be lowered from the ceiling. Large glass windows give an outlook on all sides. Buses now in development in California will be equipped with reclining chairs and wireless telephone outfits

No discussion of the future of the motor-bus is complete without consideration of special rights of way. The railroads owe much of their efficiency to the fact that their roadways are private. The motor-bus, on the other hand, has been compelled to operate entirely on public roads, where speed must be kept within limits. Our roads were originally laid out for horseback riders; many are narrow, turns are sharp, and crossings are at grade.

No Grade Crossings

Speed with safety will be obtained by building high-speed roads, without sharp turns and without grade-road crossings.

As a matter of fact, the "higher-ups" of the automotive industry have been talking for years about such high-speed arteries for inter-city freght and passenger traffic; and within the past year a Chicago promoter has organized a five-million-dollar company to build a special road, with four concrete tracks, to connect Chicago and Milwaukee. Two tracks are to be for freight and two for fast touring-cars and motor-buses. One authority has suggested that speed roads of this type be built over existing railroad tracks. Others in the automotive industry hold the view that many railroad branch lines now in use will eventually be abandoned, and that these abandoned lines will have their rails replaced by concrete surfaces. These roads will be for high-speed motor traffic.

With the improvement in motor roads, finally, and with the development of high-speed roads, six to twelve-wheel pneumatically tired cars may reasonably be expected

Can We Live One Hundred Years?

Why Some Scientists Believe the Century Is Man's Natural Span

By Dr. John B. Huber

"LOVE of life is half of health," says Dr. John B. Huber, nationally known writer on medical subjects, in this unusual article telling why we should live to the century mark.

You've heard in the past few months a great revival of discussion about this scientific theory —that man's natural life is one hundred years. What is back of it all? If it is true, why do we all die so young?

Read Dr. Huber's recipes for right living and a century-long life. Then check up on yourself. Probably you are violating more than half of these vital rules. Why not take them seriously for once?—*The Editor.*

MAN can unquestionably achieve the century mark.

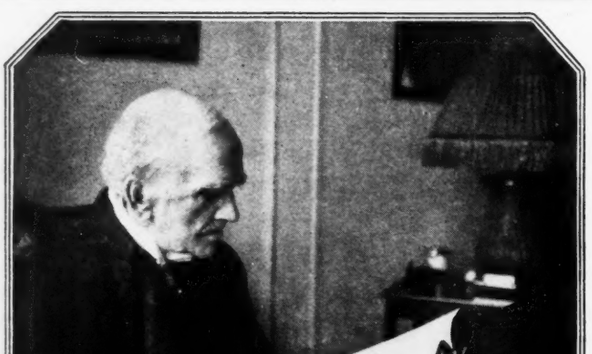
To live one hundred years and more is the natural birthright of every one. This is as well established as any hypothesis in science. Buffon, the great French naturalist, computed that the natural duration of life for any creature is six or seven times that of its period of growth. Assuming that a man's growth is generally attained at his adolescence, Buffon estimated that our span of life should be at least five score years rather than three score and ten. Many others have reached the same conclusion, which is, indeed, almost a commonplace to-day among able writers on medical subjects.

Why, then, do we continue to die before our time?

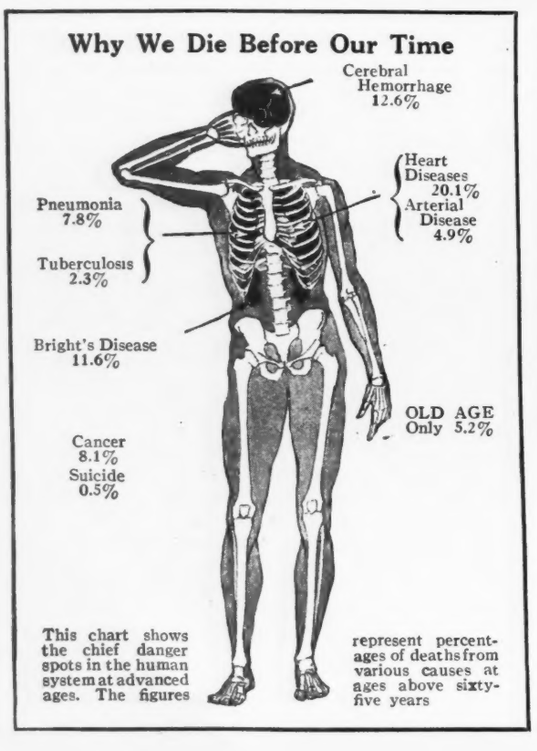
What recipes for long life do we fail to observe?

The cornerstone recipe is moderation—the most important word in any dictionary. Next to it is happiness. Judicious pleasures are conducive to love of life, and love of life is the half of health. On the other hand, sadness and gloom help on old age.

The other recipes are so familiar to us all that they may seem trite. Indeed, many scientists to-day, like Buffon, believe that longevity does not depend so much on habits of life as it does on racial inheritance. Recent studies in heredity seem to confirm, in part, this view.



Dr. Stephen Smith, at ninety-nine, is still active in public affairs. He was founder of the American Health Association and New York's first health commissioner. Hard work, hobbies, and simple diet are his rules for a long life


Why We Die Before Our Time
Cerebral Hemorrhage 12.6%
Heart Diseases 20.1%
Arterial Disease 4.9%
Pneumonia 7.8%
Tuberculosis 2.3%
Bright's Disease 11.6%
OLD AGE Only 5.2%
Cancer 8.1%
Suicide 0.5%
This chart shows the chief danger spots in the human system at advanced ages. The figures represent percentages of deaths from various causes at ages above sixty-five years

But it is not only the goal of an advanced old age that concerns you and me and every thinking man to-day. What people are talking about now is the possibility of reaching a hundred in the fulness of our powers. We want not only to be alive at one hundred, but also to feel "one hundred years young" when that birthday comes to us. We want to be disposed to transmit the gifts that have come to us throughout our years to our children to the third generation, at least.

We want to tincture the knowledge they have learned with the wisdom we have acquired, to the betterment of themselves and of our civilization as a whole. We believe that greater peace, progress, and happiness may come to mankind through a lengthening of the years in which we are active, alert, and able to learn and serve.

Now certainly it is possible to name the rules by which men could live longer than they do, and live to the end more efficiently than they do.

First, the old specific —bathe daily, in the morning if possible. Accustom yourself to the cold bath in summer so that it will not be a shock to you in the coldest weather. Always bathe in a warm room.

Eat slowly and chew thoroughly, with teeth that are well cared for. Eat three meals a day, but not excessively nor between meals. A good diet is fruits and vegetables in abundance; meat once a day (cheese is an excellent substitute at other meals) and two eggs a day. Drink at least six glasses of water in every twenty-four hours.

Stay in the sunshine as much as you can, and avoid dusty, damp, and foul air.

Go to a comfortable bed in time to sleep at least eight hours. The elderly person, and every woman, whatever her age, should rest an hour after lunch.

Wear clothing that is loose, porous, and only as heavy as is necessary to maintain the bodily temperature.

Keep your feet warm and dry. Warm footwear and stout, well-fitting, water-tight shoes are essential.

Better leave tobacco alone, until you are twenty-one, anyway. All women should shun it. Alcohol should be taken most sparingly. Only the old and the feeble need it, and they should have it moderately.

Let the unmarried youth remain content and he will gain increased mental and physical vigor and stamina. Let him marry before he is twenty-five, if possible.

Work, play, rest and do all things in life temperately. Through all perplexities and all turns of fortune preserve a serene philosophy of life.

Pure Air Means Pure Blood

Seek an outdoor occupation, if possible. Fresh air is nature's disinfectant; there is none better. The more you are outdoors, the better will be your digestion. Pure air means pure blood, and this, in turn, means well-balanced metabolism—that is, the conversion of oxygen and wholesome nutriment into healthy disease-resisting tissues that build a strong and healthy body. Indulge adequately in outdoor sports, of which walking is by far the best. And don't mind the weather. There is no bad weather, only different kinds of good weather. Stand and walk erectly, and develop a right posture.

Avoid poisonings and infections by keeping nose, throat, mouth, teeth and gums clean. Get rid of your infection centers, of which I will speak more fully presently.

Pain is a danger signal; never fail to heed its warning. Find the cause, or have a doctor find it, and remove it by the right treatment. Above all, be examined once a year so that masked symptoms will be revealed in time to forestall grave maladies.

Such illness is caused by superheated homes and workshops. Keep every dwelling, room, and shop well ventilated. If you will begin in the fall with an indoor temperature of sixty-five degrees, you can endure it throughout the winter without being chilled; and you will be all the healthier for it. The bedroom temperature should be that of outdoors, winter and summer.

Here are some maxims that are conducive to longevity:

Rise early; go to bed early; and in the meantime keep yourself occupied.

Human Machine Needs Care

Water and bread sustain life; but pure air and sunlight are indispensable to health.

Frugality and sobriety are the best assurance for a long life.

Cleanliness preserves from rust; the machines that are cared for last the longest.

A sufficiency of rest repairs and strengthens; too much rest weakens and causes flabbiness.

He is well clothed who keeps his body sufficiently warm, safeguarding it from all abrupt changes of temperature, at the same time preserving perfect freedom of motion.

The mind reposes and resumes its edge by means of relaxation and wholesome amusement, but excess opens the door to the passions and these attract the vices.

Moderate work and moderate exercise correct the autotoxemias (self poisonings) to which the elderly are prone, especially those intoxications that show their effects on the kidneys. Work improves the mental state of elderly people by engaging their minds and preventing their thinking about "old age." Money sufficient for their needs is, in many cases, better than medicine; for they should feel independent. Attention to some work or hobby would solve many problems of old age.

Begin in middle life to cultivate hobbies that you can ride comfortably in your advancing years. Nothing so ages an elderly man who has laid down his life's vocation as the lack of some occupation. Enjoyment of music is one of the best of hobbies.

At ninety-two, John R. Voorhis is active head of the New York City Board of Elections "Make up your mind to do a thing, and it's half done," he says, "whether it is to live to be a hundred, or only to finish your day's work on schedule"

The Best of All Hobbies—Work with Your Hands!

"BEGIN in middle life to cultivate hobbies that you can ride comfortably in your advancing years. Nothing so ages an elderly man as lack of occupation. Many are the men who, when they retire, promptly die just for lack of a hobby to keep them interested!

"If you live where there's space . . . cultivate long life in your garden. Wherever you live, use tools; be creative, with your hands. Make things at your workbench. A handicraft is the best of all hobbies to carry you happily toward the century mark."—*Dr. John B. Huber.*

The perception of good music is conveyed through the hearing sense of the brain, where its benignancy is in turn transmitted to the sympathetic nervous system, which directs the functions of the heart, the lungs, the stomach, and the bodily organs generally. Thus is good music not only physic for the soul, dissipating mental depression, soothing emotional disturbances; but it also enhances nutrition, furthers digestion, quickens the pulse, helps to restore organic unity. Indeed, mind, body, and soul will run together all the better for occasional lubrication with streams of melody.

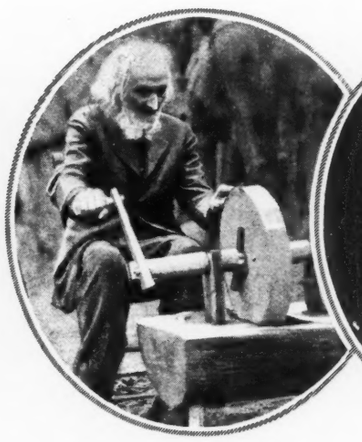
Again, any sort of handiwork makes an ideal hobby. Use tools; be creative with your hands. At your work bench and in your garden you should seek the elixir of long life.

Watch the Danger Points

But a whole archway may crumble to the ground by reason of a fracture in a single stone. The whole chain gives way when its weakest link breaks. Any little defect in a machine may result in the whole thing being thrown on the scrapheap. This is as true of the human machine as it

(*Concluded on page 89*)

Zora, an Armenian of Constantinople, claims to be 145. Zora never took care of his health until recently, when doctors prescribed a milk diet



"If you want to be healthy, don't bundle up your legs and neck," says John Shell, of Greasy Creek, Kentucky, called the oldest man in the United States. "Uncle John" claims to be 132 years old, but one investigator says that he is only 101

Ka-Be-Nah-Givey Wence, or plain John Smith, of Case Lake, Minnesota, is known as America's oldest Indian. He has lived nearly all his life out of doors, and his deeply furrowed skin is evidence that he is well past the century mark. He has outlived nine wives

Although 105, James Murray still works ten hours a day as gatekeeper at Trinity Cemetery, New York. Steady work lengthens life, he believes

Electricians Start Fires to Learn How to Fight Them

FIRES in electrical transformers and oil-switches are not only spectacular, but exceedingly hard to put out.

To determine the best extinguishers for such blazes, which are frequent because of the low temperature at which the oil may be ignited, the Pennsylvania Water & Power Company recently conducted a series of tests of various methods, including the use of carbon tetrachloride, soda, water, sawdust, and sand.

In each test, a fire was started within the transformer or oil-switch, and allowed to burn unchecked for five minutes. Wood was added as fuel to increase the heat, for the purpose of making the test as severe as possible.

How Extinguishers Acted

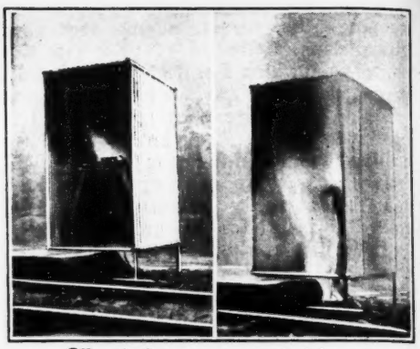
When applied at fifty pounds pressure, four gallons of carbon tetrachloride extinguished the fire in about ten seconds, but caused much smoke and flame.

Carbon dioxide from the ordinary soda tanks also gave excellent results. The stream was applied directly to the surface of the burning oil. Two two- and- one-half-gallon tanks extinguished the fire in eight seconds, while one tank required about twelve seconds.

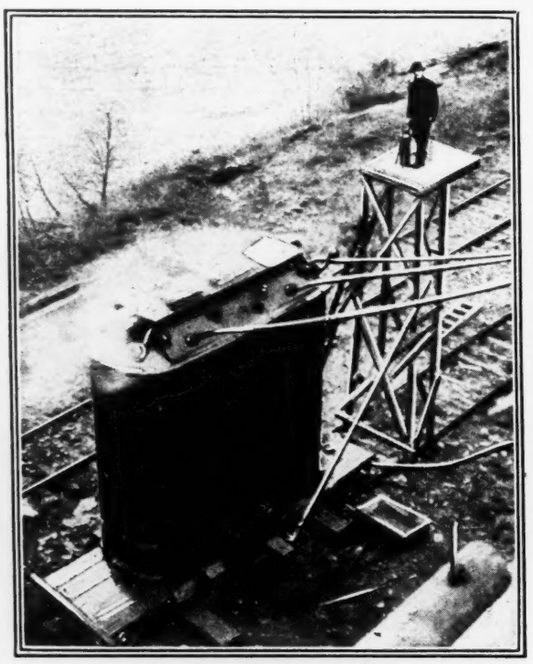
Water was effective, but when it was applied a flame twenty feet long, with clouds of smoke and steam, shot out of the transformer shell. Some oil was thrown out of the openings. A patent extinguisher similar in action to the soda apparatus in that it blankets the fire with carbon dioxide, put out the blaze in from fifteen to twenty seconds.

It was found that while damp sawdust would extinguish an oil-switch fire, a miniature explosion that threw blazing oil in all directions occurred whenever the smallest portion fell into the oil-pots. The use of sand was not accompanied by this danger, yet was just as effective in smothering the blaze.

As a result of the tests, certain precautions were formulated. Foam and soda are both electrical conductors, and if either liquid is permitted to run over an insulator, a "flash over" will follow. The transformer must be disconnected before they are used. If an operator moves too close to the fire, the jet may conduct the current to his body. A soda jet is an insulator after the stream is disintegrated into spray, but for a distance of forty-four inches from the nozzle the jet is solid and an excellent conductor. A short circuit will also result from the use of wet sawdust or sand unless the apparatus is disconnected.



Oil-switches were mounted in compartments for the tests. At the left is a fire on top of an oil-pot; at the right, a violent external blaze



Liquid extinguishers were introduced into the burning transformer through pipe connections, while external extinguishers were applied from an elevated platform

Danger of Poison Gases

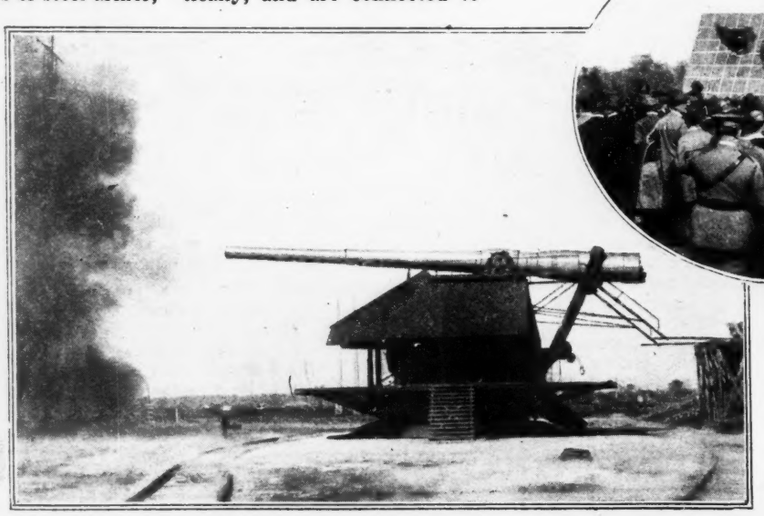
Carbon tetrachloride is a good insulator, and its use is recommended in high-tension fires. There is danger, however, in applying it in poorly ventilated locations. Tests made by the Bureau of Mines show that carbon tetrachloride will break down under certain conditions and generate the most deadly poison gases.

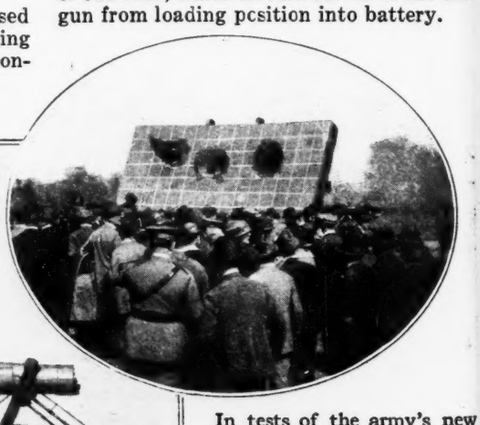
If large quantities are used on a very hot fire in a confined space, the operator should use a gas-mask.

Shell from Army's New Gun Pierces Fourteen-Inch Plate

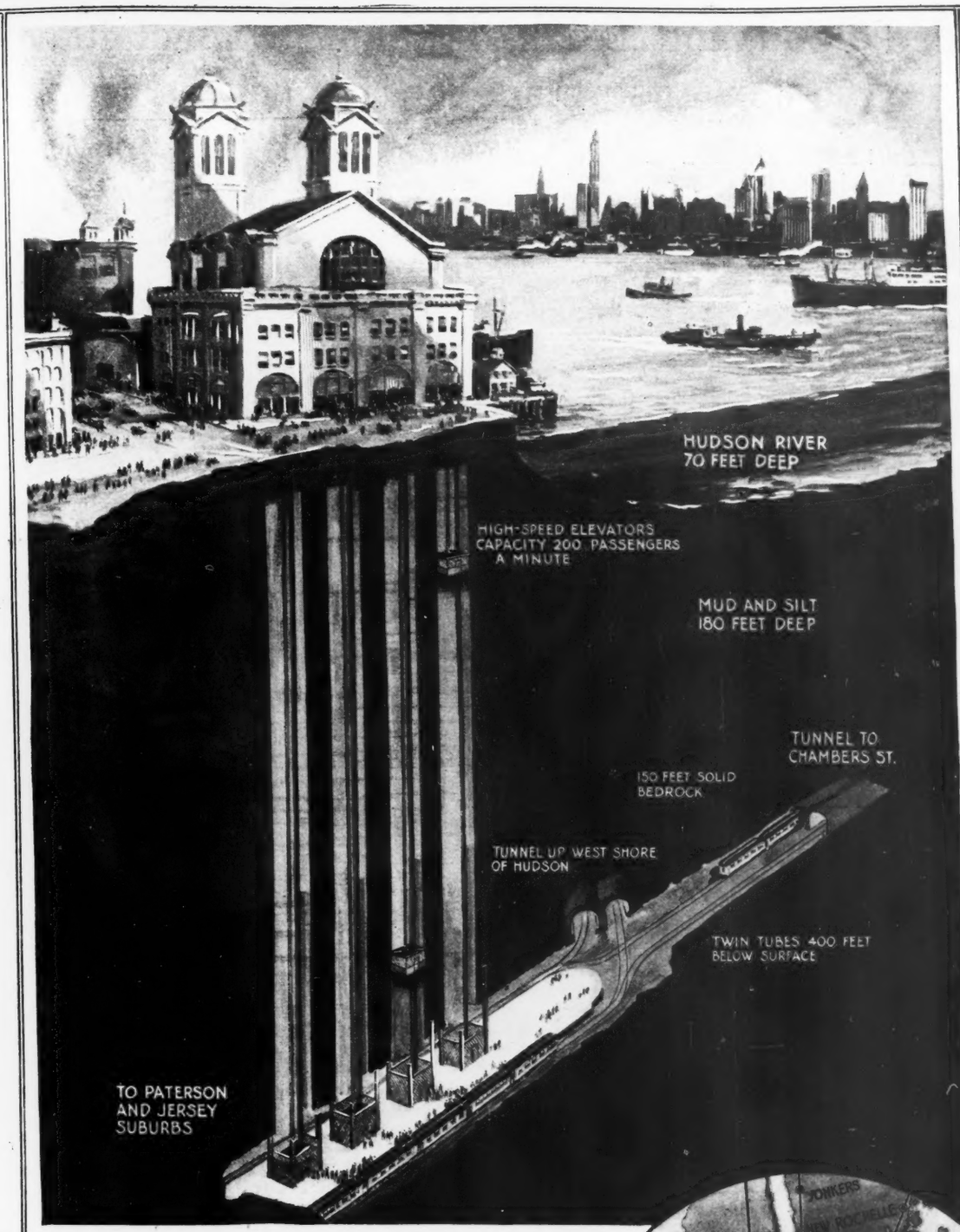
EIGHT million seven hundred thousand pounds of recoil energy, a force capable of tossing a two-thousand-ton freight locomotive two feet in the air, must be absorbed by the gun-carriage without a jar whenever the United States Army's newest disappearing coast defence gun is fired. While the shell cannot be stopped at short ranges by fourteen inches of steel armor, the gun, which travels to the rear with equal force, is checked in less than five feet with so little vibration that the gun-pointer is able to keep the sights continuously on the target.

The shock is absorbed by two closed cylinders partly filled with oil, flowing through narrow grooves in the piston-heads. The pistons move vertically, and are connected to the gun by a crosshead attached to the lower end of the gun-levers on which the piece is mounted. Some of the initial force of recoil is utilized to lift a counterweight of 315 tons, which in turn serves to lift the gun from loading position into battery.





In tests of the army's new sixteen-inch disappearing gun at the Aberdeen proving-grounds, the huge shell at the extreme left was fired through fourteen-inch steel armor plate. The roofed housing—called the "barbette"—protects the gunners and delicate mechanism from shell fragments and bombs



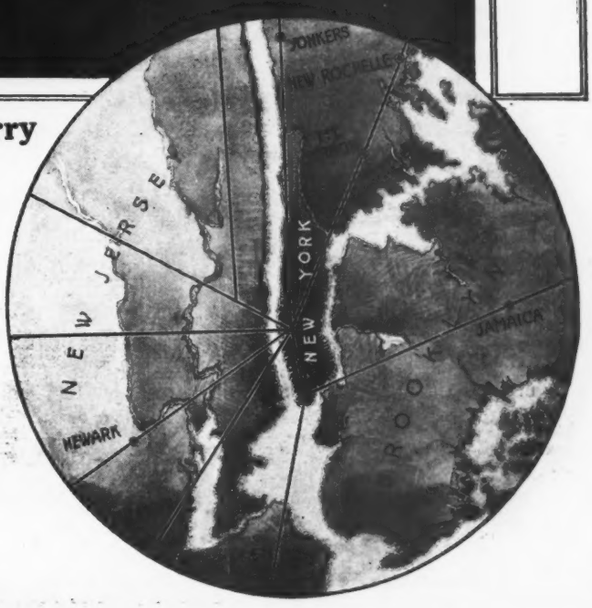
Subways Four Hundred Feet Deep to Carry Commuters a Mile a Minute

A REMARKABLE system of high-speed subways to be bored through solid rock at a great depth under New York City has been proposed by Reginald P. Bolton, noted consulting engineer, who asserts that the limitations of the present overcrowded, shallow subways have been reached.

At a depth of four hundred feet, the water from the rivers would not penetrate, and it would be unnecessary to work in compressed-air locks. The tracks would run on straight, level lines, irrespective of the course of the streets or the contour of the ground above, so that great speed and many economies in operation would be possible.

Conditions would be ideal for operating express elevators at the stations at a speed of from eight hundred to a thousand feet a minute. From the island platforms, passengers would be whisked to the street in thirty seconds.

The deep subways would radiate from Manhattan, serving the whole metropolitan population in New York and New Jersey, which is expected to total twenty million by1950. Heavier rolling stock and a speed of sixty miles an hour would be practical. Driving tunnels at this depth would not disturb surface traffic. Every detail of construction, ventilation, and operation involved has already proved a practical success in other subways, tunnels, and mines

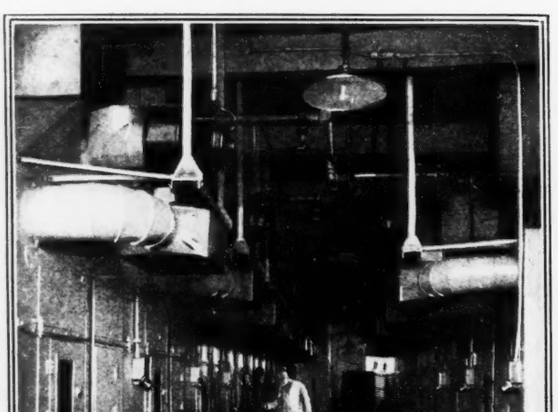


Dried Food and Drink, Holding Original Flavor, Bid for First Place on Family Table

Even Dehydrated Coffee, with Cream and Sugar, Is Possible

By James H. Collins

CAN-OPENER or water-faucet? Which is the housewife to find most useful as an aid in preparing the family meals? Shall she continue to serve canned vegetables, or shall she adopt the new dehydrated products now appearing on the market? As far as flavor goes there is very little difference. The best dehydrated food tastes almost exactly like fresh material. So do the best canned goods. In other respects dehydrated vegetables possess many advantages; but to offset these is the fact that the American public is not accustomed to eating them. Habit and convenience will make the can-opener more useful than the hydrant until a long series of advertising campaigns has educated the public in the use, and, it might be added, in the manufacture, of dried foodstuffs.



Thirty tons of dehydrated potato flour is produced daily in these ovens. The product is virtually dried mashed potatoes

Wholesale Weight Reduction

With modern dehydrating processes you can take a bushel of sweet potatoes weighing forty-six pounds and reduce it to ten pounds; a bushel of spinach weighing ten pounds shrinks to a little more than twelve ounces; a side of beef is so reduced in bulk that it can be shipped in one eighth the space required for fresh meat. Eighty per cent of water can be eliminated from milk, so that it becomes fascinating to figure out the possible economies in weight, bulk, and freight charges.

If a carload of fresh potatoes containing a thousand bushels and weighing thirty tons is dehydrated, it can be brought down to less than six tons—a load for a motor-truck. That saves freight, hauling, handling, decay, eliminates the danger of freezing, leaves all the culls and skins in the country. Every pound of potatoes is net. The housewife does not have to throw peelings or nubbins away. The economists estimate that our national bill for freight and hauling is now something like ten billion dollars a year. Dehydration promises to reduce it, as well as to save millions of pounds of perishable products which, from season to season, cannot be profitably marketed on account of car shortages, distance, gluts, and other handicups.

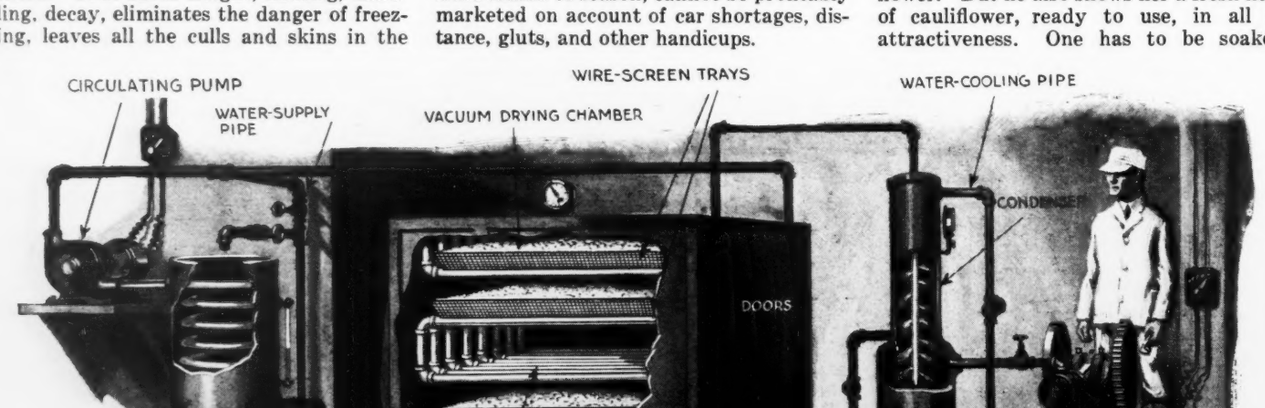
It is such a pretty thing to play with on paper that writers the past few years have been somewhat exuberant in picturing the revolution ahead in food production, transportation, and consumption. But there is another side to the subject. Dehydration has its shortcomings. The first of these is in the matter of quality.

What "Consumer Habit" Does

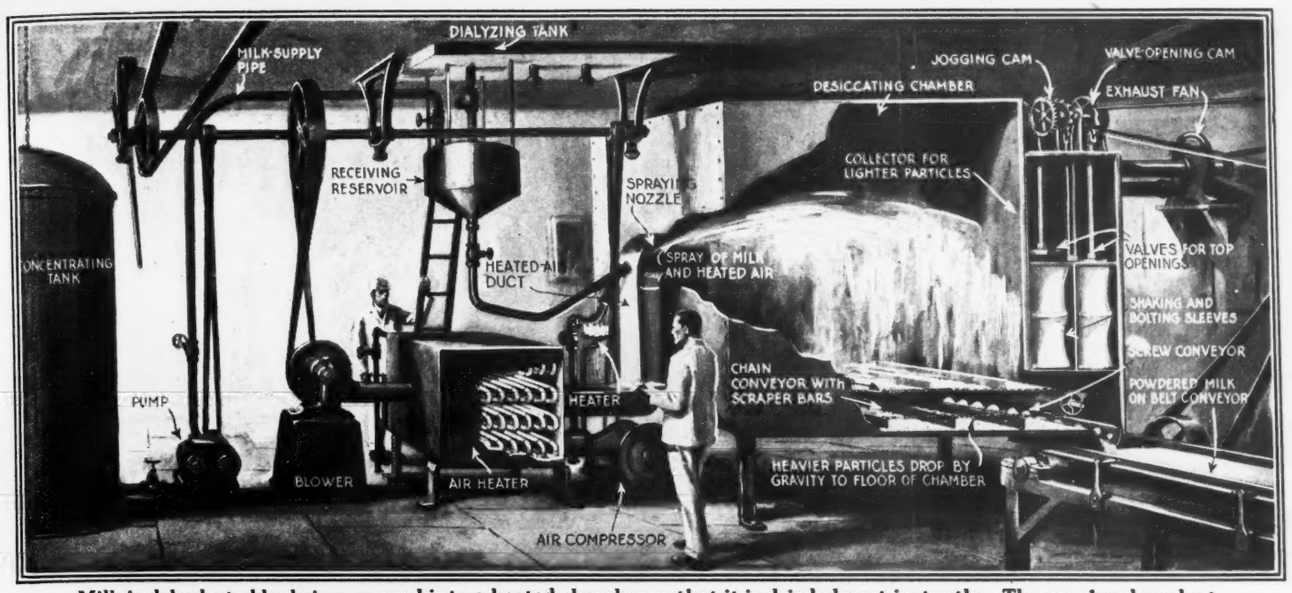
Dehydration isn't as easy as it looks. The war aroused widespread interest in its possibilities, but nine tenths of these war products were inferior. They didn't keep; had lost their flavor; wouldn't "come back" when soaked in water. Since then, improved apparatus has been devised, with one new process based on an interesting new principle, so that really good dehydrated products can now be made—vegetables and fruits dried to the point where they can be sealed up and kept indefinitely; dried so that neither their flavor nor cell structure is impaired, and certain to "come back" perfectly when soaked in water.

Even so, there remains a very serious drawback, and that is consumer habit—the partiality of people for the things they have always used and with which they are familiar.

To illustrate this feeling, suppose dinner-time is coming on. Mrs. Housewife goes to the grocery. The grocer shows her two delicacies. He takes one of them out of a tin can. It looks like a dried mushroom. She is assured that, soaked in water, this will become a beautiful head of cauliflower. But he also shows her a fresh head of cauliflower, ready to use, in all its attractiveness. One has to be soaked,



Vegetables are slowly dried on shelves, the heat, degree of vacuum, and percentage of moisture being carefully regulated. The period of drying varies with the vegetable and the size of the pieces into which it is cut



Milk is dehydrated by being sprayed into a heated chamber so that it is dried almost instantly. The powdered product is scraped from the heated walls of the chamber by moving bars, and is delivered automatically to the bolting-sieves

which takes time, and the dinner-hour approaches. The other is ready to cook immediately. The fresh head of cauliflower suggests dishes, while the dehydrated stuff in cans and boxes does not. If she wants tomatoes, too, for supper, the can-opener is a familiar proposition, while soaking dehydrated tomatoes is not.

In other words, selling the housewife dehydrated foods is an educational job, calling for time and money, something the average retail grocer cannot undertake. That is the job of the dehydrating concerns, and will necessitate a large expenditure for explanatory advertising and demonstrations to housewives.

A Job for Business Men

Dehydration is a business for business men, rather than one for growers to go into cooperatively, or to be established by a community seeking new industries. The small plant operated by farmers, or on a community basis, would be under the same handicaps in its output as the girls' canning club—that is, lack of standards and quantity output. In the present state of this new industry, the work of showing consumers how to use the unfamiliar novelties, is a job for experienced sales and advertising experts, backed by liberal advertising appropriations.

Popular interest in dehydration has centered on farm crops. But the actual growth in scientific drying today is found in industrial fields.

In the experimental laboratory of a New York engineer specializing in dehydration, the writer was shown a miniature drug-store of interesting new products. Powdered coffee was one of his newest achievements. He made it, not by pulverizing the coffee bean, but by brewing good coffee such as you like at breakfast, and then passing it through an apparatus that sprayed it into a chamber where heat instantly evaporated the water, the solid particles of the brew falling as powder to the floor. This powder, put in hot water again, immediately became coffee, and one could even have the milk and sugar in it if desired. There was dried orange-juice, which, stirred in water, was exactly like juice from the fresh fruit; and dried lemon-juice, which made a lemonade that one would never have suspected of passing through anything more complicated than a lemon-squeezer. Grape juice, milk, yeasts, enzymes, rennet—these are all dehydrated and furnished in powder form. Pectin is that peculiar chemical agent in fruit juices that puts the "jell" in the jelly. It can be extracted from apples, oranges, and other fruits, dehydrated and powdered. The sulphide liquor from paper mills, formerly a troublesome waste, is now dehydrated and used by the molder in foundries, as well as for road-making and other purposes.

It is along these lines that dehydration is being applied most successfully to-day, and out of the industrial advances of the art successful applications will probably be made to soil products.

Better apparatus has been developed, along with more skill and knowledge. In such processes as that of drying by moist heat—which sounds paradoxical, doesn't it?—the industry will probably develop.

The possibilities are alluring.

The other day a California company shipped its first carload of pumpkin flour to Eastern markets, a product made by dehydrating pumpkins and drying them into flour. Besides pumpkin flour, this concern turns out dehydrated potatoes, carrots, turnips, onions, rutabagas, spinach, string-beans, a vegetable soup, and a "New England dinner." It also dehydrates peaches, pears, apricots, apples, and prunes.

New York's transit plans for the next twenty-five years are laid out on a scale to take care of a city of 8,000,000 to 10,000,000 people. To-day, New York draws its milk supply from a radius of 200 to 300 miles. As it grows, the problem of getting sufficient fresh milk from surrounding territory will become difficult. The solution of New York's future milk problem may be dehydration—powdered milk—milk minus its 87 per cent of water, light, creamy, and with long-keeping quality.

When dehydration first began to attract attention, it was thought of as a substitute for canning. Many striking comparisons were made, showing the saving in bulk, freight, tins, spoilage, and so forth of dehydrated over canned products.

Dehydration Prevents Waste of Food

But to-day it looks as though this new specialty would be an extension of the canning industry instead. The process lends itself to products that are not canned on a large scale, such as potatoes, cabbage, turnips, onions, beets, carrots, and parsnips.

The canner has steam, machinery for peeling and slicing, his trained workers, his contracts with growers. It was thought that any surplus of fresh stuff that could not be handled during the canning season might be dehydrated and later soaked back and canned.

Five to ten million pounds of potatoes are dumped in New York City alone annually, while it is estimated that 54 per cent of the output of fresh fruits and vegetables go to waste in this country every year. Dehydration will eliminate that waste—technically. But the better a new product or idea, very often, the more slowly it grows. Canning was first brought to this country in 1821, but it took twenty years to apply it to one product, oysters.

Ultimately dehydration will be of untold benefit to the farmer as well as the public, but its promotion is the important task now.

Are You, Too, Learning to "Listen in by Radio"?

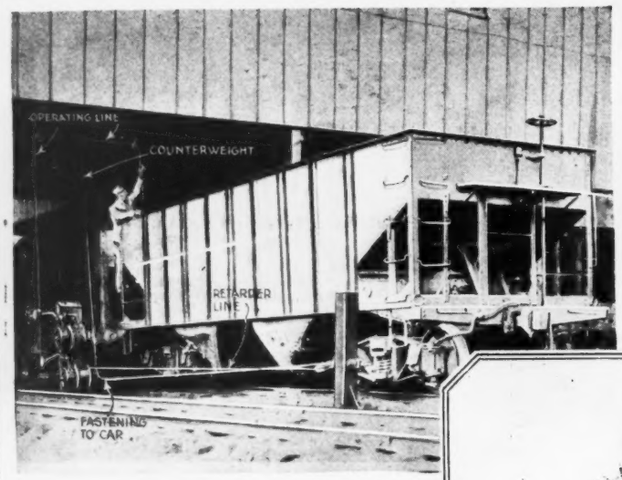
The following letter is typical of scores received from our readers

"THE EDITOR, Popular Science Monthly:

"The feature on wireless that appeared in your November issue certainly hit the mark. . . .

"Five minutes before reading the article, the writer knew nothing of wireless, except that it existed for the benefit of ships in distress. Now he knows better, for he is the owner of a new receiving-set, purchased soon after your article appeared, which is dispensing joy to the entire household, as well as to the neighborhood.

"JOHN SIMPSON,
"52-58 Duane Street, New York City."



Checking a Freight-Car with One Hand

COAL-CARS are loaded without ridges or hollows, and the movement of the car under the coal-tipple is in perfect control at all times at mines where the car-retarder illustrated is part of the loading equipment. As the cars run by gravity under the tipple, they are checked by a cable wound on a pony brake operated by a line running over pulleys to the point where the loader stands beside the coaling chute. The apparatus is mounted on a post twelve feet high set outside the shed.

Simple as the arrangement appears, now that it has been invented by J. J. Ross, the device means uniform loading, easier work, and increased safety. It is no longer necessary to rely on the notoriously poor hand-brakes of the freight-car, nor for the loader to get out of the car, start it moving with a pinch-bar, and jump back on again to set the brakes.

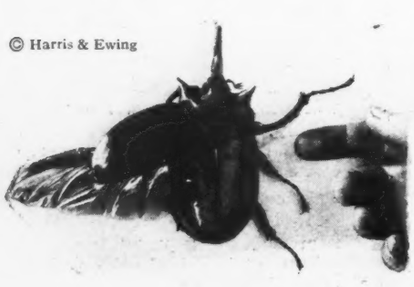
PURE carbon is transparent to X-rays; mineral matter is opaque. By taking X-ray photographs of lumps of coal, it is possible to get accurate knowledge of bands of dirt and other impurities in the mine seams that could not otherwise be discovered with chemical analysis.

Giant Beetle from Honduras

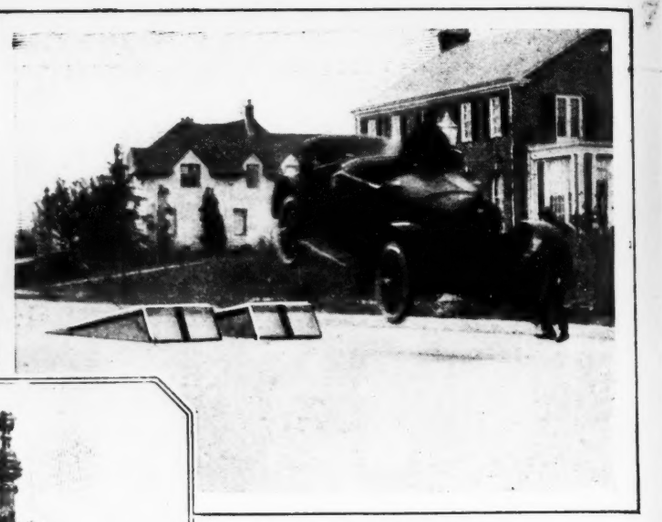
NOW in the National Museum at Washington is this enormous beetle, a native of Honduras. It is five inches long and nearly three inches wide and is the largest beetle found in the tropics so far as is known. It has no rival in size in the United States, although it belongs to the same family as the well-known June bug.

Entomologists have classified eighty-five distinct families of *Coleoptera*—the scientific name for beetles.

© Harris & Ewing



The gigantic size of the Honduras beetle is indicated by the man's fingers beside it



Automobile Makes Jump of More than Eighty-One Feet

HURLING his machine clear of the road for a distance of eighty-one feet six inches, Jack Fox is believed to have established a new world's record for automobile jumps.

The leap was made by building two runways eighteen feet long and about two feet high at the farther end, the runways being placed in the middle of a concrete road as illustrated. The car was driven up this take-off at a speed of seventy miles an hour, and flew eighty-one feet six inches before striking the road again.

The automobile used in this feat weighs approximately twenty-four hundred pounds, and such a jump is the severest possible test of the springs. These stood the strain admirably. No special bracing was installed, and after the jump the car was driven back to town without repairs or adjustments of any sort.

FLYING at forty miles an hour, a carrier-pigeon, owned by S. Uprichard, covered the 228 miles between Washington and New York in four hours and fifty-eight minutes—one hour slower than the railroad expresses.

Tree Still Grows on This Indiana Courthouse Roof

THE famous tree on the roof of the courthouse of Greensburg, Indiana, is still flourishing. Originally there were two trees, but one blew down in a storm.

The tree depicted has been growing in this elevated location for fifty years, its small size being due to the fact that there is little nourishment for growth; but year after year the tiny amount of soil in the stone roof keeps the plant alive.

Dynamite Tested by Miniature Explosions in Cylinder

IN a laboratory of a prominent powder manufacturer stands a massive cylinder with a door at one end resembling the breach-block of a modern big gun. On top of the cylinder is a device that looks like a steam-engine indicator. The machine is a pressure gage for testing dynamite.

A small charge of dynamite is placed inside the cylinder and exploded. The indicator on top registers the pressure on a revolving card, the final curve showing how violently the combustion occurred.

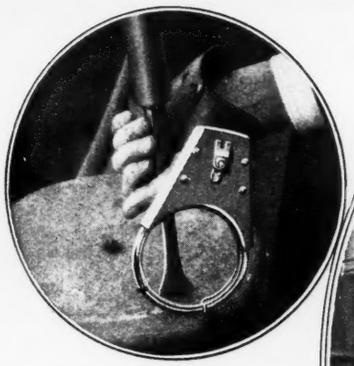
After the detonation, samples of the gas are drawn from the inside of the cylinder. This is analyzed to see that the by-product gases would not be injurious to workers in mines and confined places.

Manhattan Had Cliff-Dwellers

DISCOVERY has been made of several caves in upper Manhattan where it is believed the Indians made their homes in the cliffs.

The picture shows one of the most desirable of those early New York flats. Through the assortment of relics that were found, it is safe to assume that the Indians of the cliffs wove their own cloth and made tools, baskets, also many household decorations.

Ruins discovered in New York City would indicate that cave-dwellers once lived there

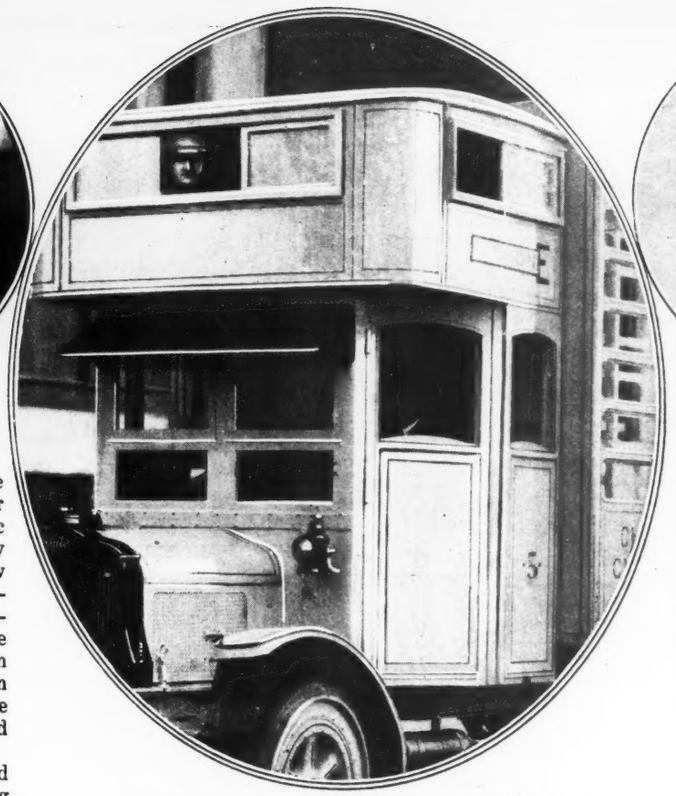


Guard for Chiselers Is Attached to the Hand

A GUARD to protect the face and eyes of the worker while operating a pneumatic chisel has been invented by Isak O. Torkelson, of New Brighton, New York. The device includes a strip which fastens about the bottom of the hand and carries a shield which has a glass window inserted in it, through which the edge of the chisel may be seen and guided while cutting.

The danger to the face and eyes of chiselers from flying chips is eliminated by the use of this device. The guard is also a useful one for those using any kind of hand tools on brittle material.

ACCORDING to figures compiled by the Smithsonian Institution, the United States is making use of 150,000,000 horsepower annually. This is equivalent to the labor of three billion slaves. On this basis each one of the 110,000,000 people in this country has thirty mechanical slaves working for him.



Sleeping Quarters for the Truck Crew

FOR relief drivers a bedroom above the cab makes this truck pile up the miles on its overnight trips between Chicago and Detroit. A sleepy man isn't going to get the most mileage out of his gasoline, and by adding this cabin, the owners have utilized what was wasted space for the comfort of the crew.

The cabin contains one bed similar to a ship's berth. It is reached by climbing a ladder placed at the right of the driver's seat through a trapdoor. A man has only room to lie down, but it is far more comfortable to sleep in a real bed than to snatch forty winks in a seat at the driver's elbow.

BRITISH experts have estimated that the known available coalfields insure an adequate supply for the normal needs of the world for four thousand years.

Electric Toothbrush for Home

BRUSHES of the standard dental type mounted in a flexible shaft driven by a small electric motor operating on the lighting circuit, enable the teeth to be cleaned as thoroughly in the home every morning as they are at the end of the semi-annual visit to the dentist.

In principle the novelty illustrated is exactly the same as the electric toothbrushes used in the dentist's chair. The improvements simply enable it to be operated by a child or person without mechanical knowledge. Individual toothbrushes are inserted in a friction clutch, and the speed is controlled by the pressure of the thumb.

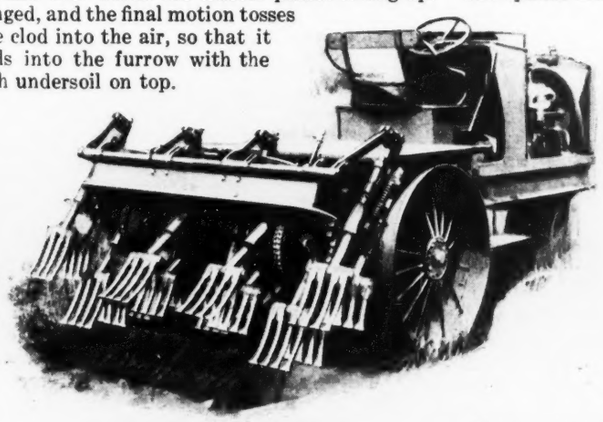
HEADACHES can be cured with a button. Not a special button, but the ordinary variety, of any shape or color the sufferer may happen to have at hand. "Simply place it in the mouth and the pain will soon disappear," declares one of the professors in a well-known medical school in Massachusetts.

Spading Tractor Burns Little Fuel

IN tests that were made at Rockford, Illinois, of the spading tractor shown below, which is of Swedish invention, the fuel consumption was found to be less than a gallon of kerosene an acre.

Besides this economy in fuel, the tractor spaded three acres of land sixteen inches deep in one hour.

The spades work by reciprocating levers operated by cams on the rear axle, which is chain driven. There are four strokes in each cycle, and the spades are arranged in batteries four deep, so that the digging action is continuous and every foot of the ground over which the tractor passes is dug up. The spades are hinged, and the final motion tosses the clod into the air, so that it falls into the furrow with the rich undersoil on top.



The blades dig into the ground, lift the turf, and toss it so that it lands bottom up in the furrow

Is This the West's Oldest Automobile?

JUST how old this automobile is, no one is quite sure. Its owner, O. J. Stough, of San Diego, California, who is one hundred and three years old himself, thinks he drove it in 1881, but his memory may be at fault. Some of the engine parts are marked 1897, which makes the car at least twenty-five years old.

Any one who remembers when the Mobile Company of America was prominent in the manufacture of automobiles can help to date this old-timer, which is a relic of the days when automobiles were really "horseless carriages," and shows the progress made by the second largest industry in the United States during a short quarter of a century.

He remembers driving this horseless carriage in 1881. Engine parts prove the car is at least twenty-five years old

Shade for the Desert Motorist

POSSIBLY this umbrella was made for a lowly horse-drawn vehicle, but in motoring through the deserts of the West it does not pay to be too proud, and the wise tourists include it in their kit.

It takes up comparatively little room in the tonneau, and when a tire must be pumped up or engine repairs made in a temperature of 130 degrees in the shade, a cotton umbrella is worth its weight in gold.

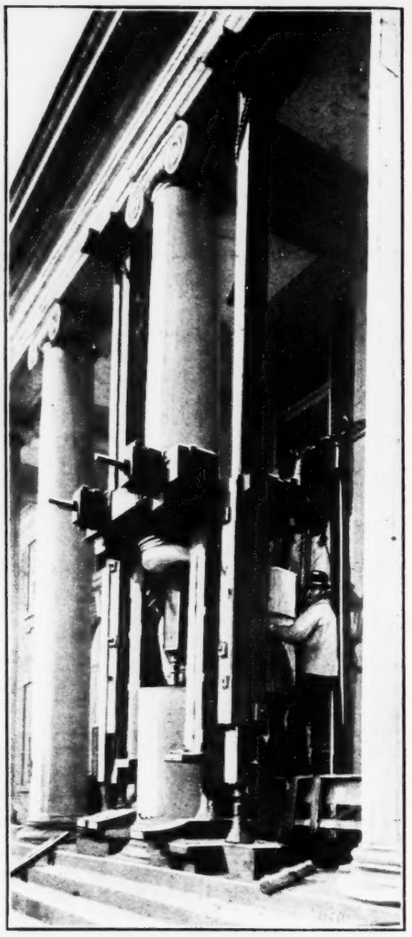
It Must Be like Bathing in a Telephone-Booth

BATHROOMS are by no means common in European houses, and a German is trying to market a portable cabinet for combination shower, tub, and vapor baths. As the photograph shows, he has made it ornamental, so that it may be placed in any room in the house. When the tenant moves to another tubless house, his little bathing-booth goes with him.

Permanent connections can be made with water-pipes, or a hose connection will

In Europe, portable cabinets are being used for bathrooms, which are a rarity

do. Used with a kerosene or an alcohol heater, steam may be generated for a vapor bath, and the bath is equipped with an apron to concentrate this steam upon the bather, when he has all the sensations of trying to get a party-line call in a telephone-booth on a warm day.



Could They Build a House from the Roof Down?

CLEVER rigging and an adaptation of house-wrecking methods, enabled builders in Bridgeton, New Jersey, to replace a section of a stone column which had been damaged.

The weight of the portico was supported by two upright beams resting on jacks. To prevent the upper sections of the column from falling, wooden beams were clamped around the stone by inch and a half bolts, and ropes were used to make this fastening more secure. A second set of jacks was placed beneath.

The damaged section was then cut out. For a time the column seemed to be resting on thin air. The jack in the gap of the stonework is not necessary, but was put in to avoid all possibility of accident while the new section was being slipped into place. Without this arrangement of jacks, it would have been impossible to repair the column without pulling down the building.

Making Real Rubies

IN the Heller laboratories in Paris there are chemists who are able to accomplish in a few hours what nature requires thousands of years to complete.

It was after years of experimenting, that M. Werneuil produced in his own laboratory a genuine ruby. Since then not only rubies, but many tinted sapphires also have been made. That they are the real article, as perfect as nature's precious stones, is proved, and they answer to every known test. They contain exactly the same substances as natural gems, and are subjected to mechanical forces that are similar to those employed by nature in her laboratory underground.

A One-Man, One-Rail Barrow

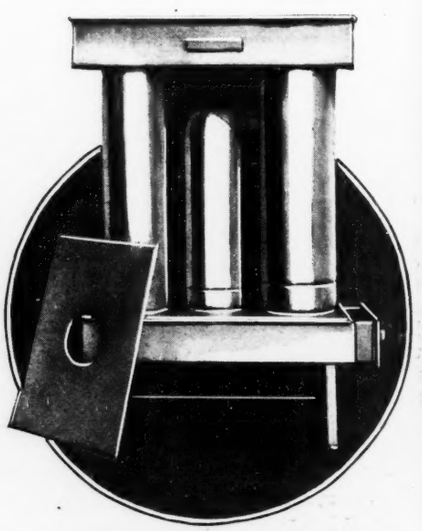
WORKERS on railroad right-of-ways in America use a small one-rail truck for the conveyance of rails and other material, the truck having handles at either end by which two men can pull and stabilize it.

In Europe, where greater economies are necessary, this one-man truck has been brought out, and its stability and motive power on the single rail may be maintained by one man using a six-foot pole. The box with which it is fitted in the illustration, may be taken off for a load of rails. The box has sloping sides to centralize a weight of loose material, but so great is the leverage of the long pole that this is only a small advantage.

Making a Handful of Fuel Heat a Room

ANOTHER contrivance contributed to alleviate suffering from the cold in Europe this winter, when coal will be scarce and dear, is this little "quick hot oven" which a small handful of wood and one coal-dust briquette are said to make formidable against cold temperature in a medium-sized room in not more than five minutes.

The "stovette" is used alone, or reenforces a regular coal-heater when it is connected (for a draft) with the stove door, the per-



A handful of fuel in this three-tube stove is said to heat a room in five minutes

forated square of metal being provided to fit over the open door. The hot gases circulate up one of the outer sheet-iron tubes, down another and then make their escape out the bent center one, in the meantime having yielded most of their heat, which is radiated in the room.

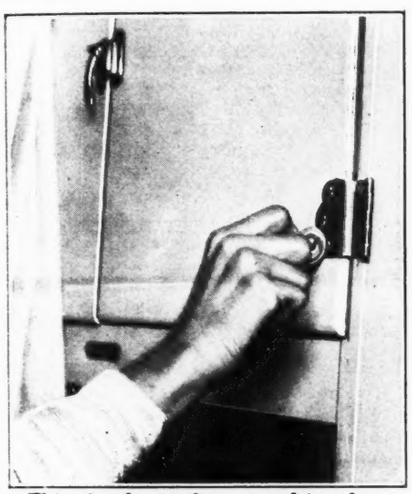
Plane's Fuel Cost only Two Cents a Mile

THE Fokker monoplane illustrated is believed to hold the record for economical fuel consumption. It recently carried five passengers 228 miles between Washington and New York at a cost of $5.80 for gas and oil.

This machine is one of the commercial planes that is being widely developed in Europe. The passengers are carried in an enclosed limousine body, and every effort is made to streamline the entire car to reduce air resistance and fuel consumption. The gasoline tank, for example, is carried in the interior of the metal wing. The maximum speed is 110 miles an hour, and the carrying capacity five passengers and the pilot.

Screwdriver Fits Every Head

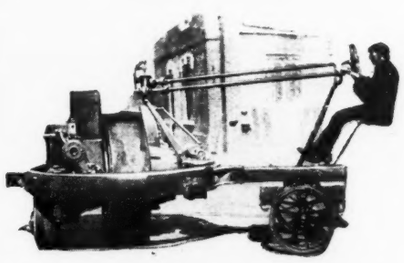
A CIRCULAR pocket screwdriver no larger than a quarter, designed to be carried on the key-ring, has a graduated edge that makes it fit screws of every size.



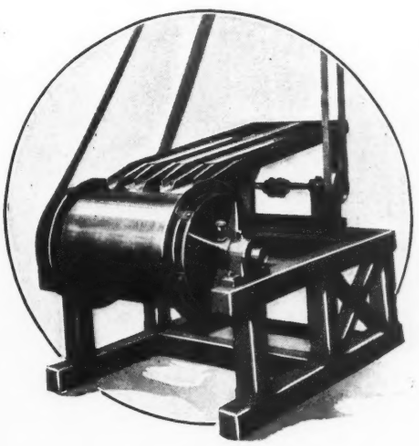
This circular pocket screwdriver has a graduated edge

It is meant for a handy tool for emergency jobs around the house or automobile and to do away with the use of knives and manicure scissors for purposes for which they were not intended.

One-Wheeled Tractor Turns in Its Own Length



DESIGNED to plow between the rows of vines in cultivating a vineyard, this one-wheeled tractor of French invention will turn in its own length and work in a space only five feet wide. The single wheel is run by an ordinary gasoline motor, and is steered by a gear wheel turned by the driver, which engages with a circular rack on the inside of the horizontal ring.



Recovering Coal from Ash Waste

ELECTROMAGNETIC machinery has proved more efficient in recovering coal and coke from the ash residue taken from hard-coal furnaces than the mechanical separation processes previously in vogue. The electrical process is dry and is based on the magnetic properties of slag. Almost all coals contain iron compounds, mostly in the form of pyrite, which are converted into magnetic iron oxides by the process of combustion.

After sifting the residues they are introduced into a rotating drum separator comprising electromagnets. While any magnetic parts—coal and coke—are thrown off the drum, the slags are kept back by the strong magnets until they enter the non-magnetic zone, where they in their turn are dropped.

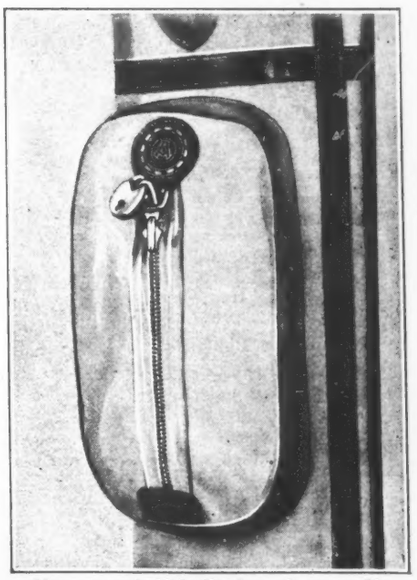
The consumption of electrical energy is only about one kilowatt for each ton of gross slag.

What Do You Want to Know?

THE "Questions and Answers" service inaugurated by Popular Science Monthly is conducted for the sole purpose of supplying its readers with information on specific questions in science. A number of actual questions with their answers will be found in this issue on page 26.

No More Lost Golf-Balls Unless You Play Badly

GOLF-BAGS of the latest design have pockets for balls, with padlocks attached. When the lock is open, the pocket may be opened full length by one downward stroke of the hand. The hasp



No more golf-balls lost from golf-bags if this neat-looking padlocked case is used

holds the patented slider in place. The slider slips down easily, displaying all the balls inside and providing a sufficient opening for the choice of a ball. Then with another sweep of the hand, the slider closes.

A FLYING swarm of locusts may be fifty miles in length, and so dense that the sun is hidden. Even at noonday the country becomes dark as night.

An Alarm-Clock that Solves the Servant Problem

WHENEVER Walter Smith, of Frankford, Pennsylvania, wants to get up in the morning (meaning, of course, when he has to), the alarm-clock calls him out of bed.

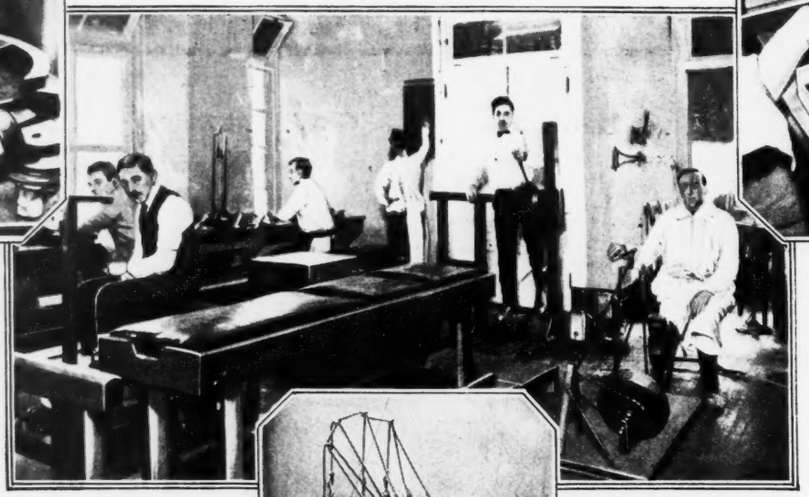
But that is only one of the things the clock does. At the same time the clock turns on the bedroom light and starts a fire beneath the kettle. As soon as the water boils, the kettle automatically tips and pours it into the waiting teapot. The drip from the kettle puts out the fire.

When Smith is dressed, his breakfast is waiting for him, and all he has to do is to remember to wind the clock and fill the teapot.

A Human Repair Shop

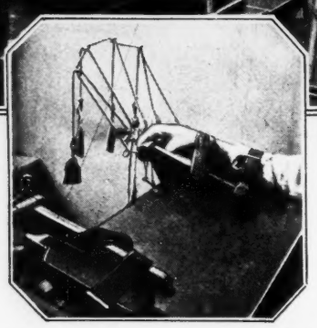
In reconstruction hospital, damaged limbs are restored by mechanical devices

Above: As the crippled hand responds to treatment, daily progress is charted by placing the arm on this board and marking the angle or crookedness of the bent fingers



Above: The wrist-loosening device. The stiff hand is held on the wooden strip on the wheel as the patient endeavors to turn it, the exertion gradually flexing the wrist

Above: The mechanical room, where the patient goes for final treatment after the injured member has been repeatedly massaged and baked in an electric oven. In this room are machines for loosening muscles of the finger, thigh, knee-joint, and ankle



At the left: A finger-flexing machine comprising a board to which the wrist is strapped and a series of weights attached to the fingers. By moving his fingers, only slightly at first, the weights straighten out the muscles and restore the hand to use

Automobile Top Is a Motor-Boat

The top is detached and converted into a motor-boat by placing a "kicker" engine on one end

HALF the pleasure of motoring along the banks of a beautiful river is lost if you are unable to push off in a boat and go sailing—at least, so thinks John A. Cowan, president of the Kansas City Conservatory of Music. To enable the automobilist to go motor-boating whenever the fancy strikes him, he has invented a camp automobile with a removable top that can be converted into a motor-boat.

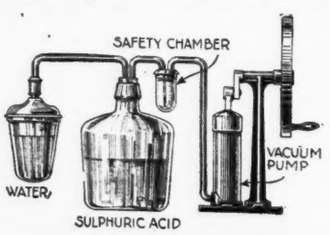
Arriving on the banks of a stream, one man can slide the top off on its rollers and carry it to the water. A detachable motor furnishes the power. Mr. Cowan is a great believer in comfort on the road, for his auto-camp is equipped with a hot- and cold-water supply as well as a boat.

ON board ship considerable trouble results when rats eat away the insulation on the electrical wires. To meet the situation, one manufacturer of wire mixed rat poison with a rubber compound that is used to rubberize the tape wound on the conductors. This scheme was very effective.

Machine Makes Ice at Home in One Minute

UTILIZING the drop in temperature which is produced when water is evaporated in a vacuum, a French invention enables ice to be made in one minute in the home with a hand-operated machine which a child may run. Turning the wheel slowly for one minute produces about half a pound of ice in the container at the left.

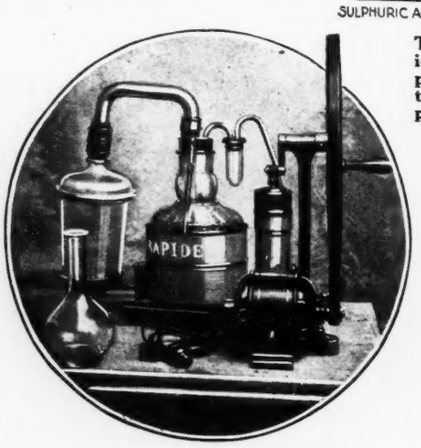
A measured quantity of water is placed in the container. The cylinder at the right is a standard air pump, operated by hand or by an electric motor. The larger flask in the center is filled with concentrated sulphuric acid, and the smaller bottle is a catch basin to prevent the acid from being carried accidentally into the pump.



The homemade ice-machine depends on the attraction of sulphuric acid for water vapor

When the vacuum is produced the water starts to boil away, and the water vapor given off is absorbed by the acid as fast as it is formed. The water is really boiling, only, in this case the heat necessary to produce water vapor is absorbed from the water itself instead of being supplied by a stove. For every centigram of water evaporated, 80 calories of heat are absorbed. Before the water in the container is half "boiled" away, the temperature of the remainder has become so low that it freezes.

This method of making ice is especially suited to the needs of a small family, but with a larger apparatus, operated by a motor-driven vacuum pump, hotels or large restaurants may supply their patrons with ice-water for which the ice was frozen in the water-bottle. As the ice is made from pure water and does not come in contact with dirty hands, tools or containers, it remains thoroughly sanitary.



One minute after the pump of the ice-making set is started, the water is converted into ice

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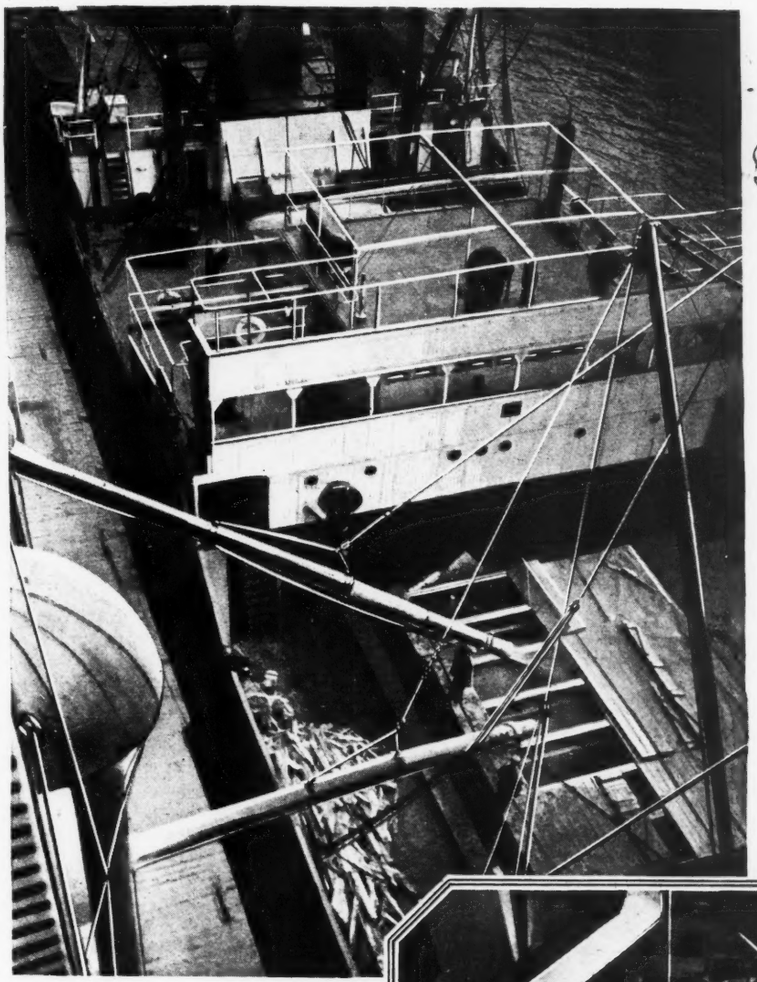
AT last, a real solder for aluminum is reported from England, said to make all the usual solder repairs and to produce a union stronger than the surrounding metal. The parts should be slightly roughed with a file, heated, tinned with the special solder, and then joined. The joint may be quenched in cold water as soon as it has set

The grain-despatcher at his desk controls every operation that goes on within the elevator

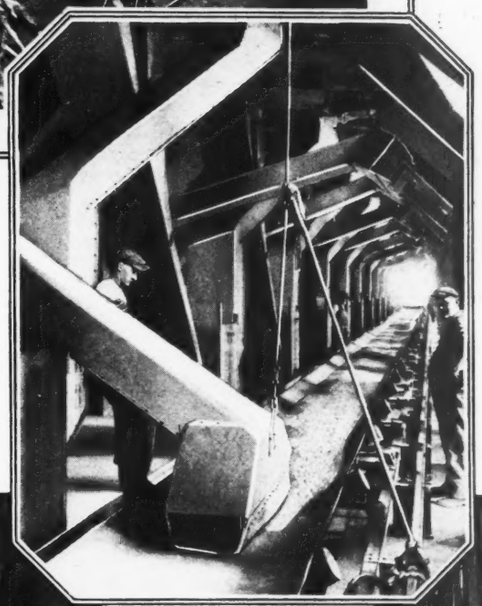
One Million Pounds of Grain an Hour

AMERICA'S most modern grain-elevator situated at Locust Point, near Baltimore, has a remarkable record of handling 52,000,000 bushels a year. The elevator itself holds 2,500,000 bushels. It is equipped with the latest belt-conveyors, dust preventives, and weighing machines. Over 7500 horse-power of electrical energy is required to operate the machinery



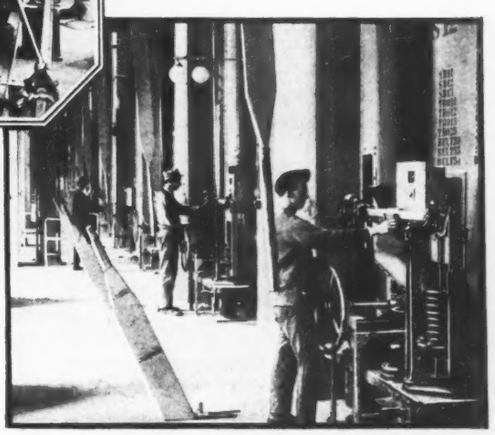
When a ship draws up to the elevator for grain, two huge spouts are lowered so that their ends enter the hatches and the deluge of grain commences. Grain-elevators are purposely built high so that the grain may be run by gravity into the ships or cars

Photographs © Ewing Galloway



Grain pouring through a chute on to a belt-conveyor. The conveyor may take the grain to a near-by ship or to waiting strings of box-cars

In lifting grain, this elevator is lowered until its end is buried in the grain. Then revolving buckets lift the grain to other conveyors



These men are stationed at scales that weigh the bulk of grain as it is emptied into or taken from the steel bins shown at the right

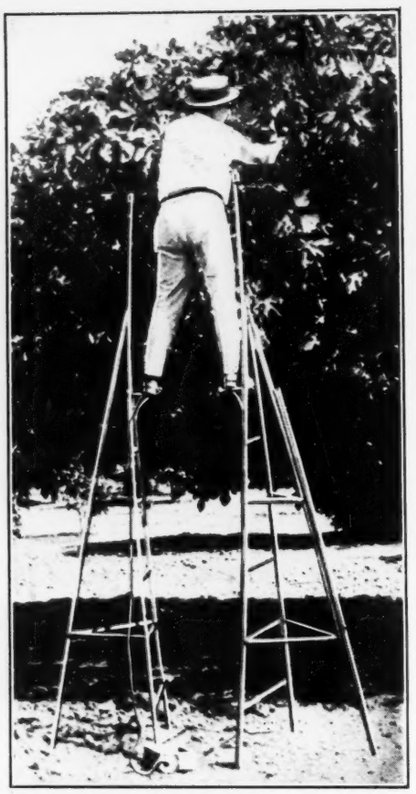
Elastic Key-Ring Chain Made of Steel

THIS key-ring chain is made of steel and is apparently of the usual length and size, but if necessary it will stretch to the length of a man's arm. The links are formed of little coils of piano wire, which are strong enough to prevent the keys from being lost, and yet sufficiently elastic to permit the key-ring on its chain to be used as readily as a single key held in the hand.

Sanitary Telephone Mouthpiece

PADS moistened with antiseptic fluid destroy every germ near this sanitary telephone mouthpiece, so that it may be used in safety even during epidemics.

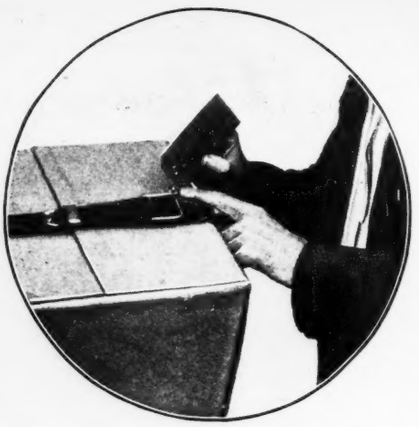
The hinged cover is connected with the receiver hook by chain and lever and opens whenever the telephone is used so that the disinfectant has a large active surface. Replacing the receiver closes the cover tightly and keeps the pad moist.



Stilts Take Place of Ladders in Fig Orchards

MEN who take the fruit from the tops of fig-trees in California go about their work on light triangular stilts, on which they also walk from tree to tree. The lattice form with its broad bearing surface on the ground makes it easy for the picker to balance himself, and enables him to lean far forward to gather the figs in the center of the tree.

The women use a light platform mounted upon bicycle wheels to gather the fruit from the lower branches. As the figs are picked they are placed in light boxes with cardboard sections so that the fruit will not be bruised by undue jolting on the way to the market.

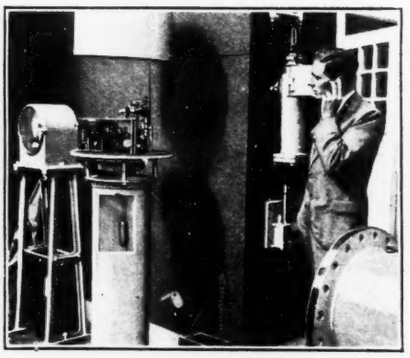


An Improved Buckle for Tying Packing-Boxes

QUICKER packing and better appearance are secured by an improved buckle provided with an attachment to which shipping-tags can be fastened without the use of string. The inventor, George R. Thurman, of St. Louis, worked as a department-store packer. Fiber boxes fastened by a strap and buckle were used to pack small articles, and he noticed that the containers returned with from six to eight inches of string left tied to the strap.

The waste of string and the loss of time occasioned by cutting off the ragged ends, led him to invent a buckle with a clip inside and a stiff spring to hold the shipping-tag in place after the clip was slipped through the eye of the tag. The inventor believes that where this buckle is in use packers can ship 20 per cent more material, since the loss of time previously spent in slipping the string through the eye of the tag, under the strap, and then tying a knot is eliminated. The value of the string saved will pay for the improved buckles.

Water-Level Indicator Makes Verbal Reports



FITTED with a phonograph attachment, the mechanical water-level indicator illustrated makes verbal reports over the telephone to the engineer in charge. This is accomplished by synchronizing the phonograph with the level-recording apparatus. As the float in the reservoir rises and falls, the tone-arm of the phonograph is moved laterally over the record so that it will give the correct reading when the needle comes into contact with the disk.

The bell-ringing currents of the telephone start the clockwork going, which lowers the needle to the record and lifts it off again after the report is made. The record has space for two hundred readings, which announce the height of the water in percentages from empty to full.

Monoplane Flying-Boat Sets Altitude Record

PILOTED by David McCulloch, this Loening monoplane flying-boat rising over Port Washington, Long Island, reached an official altitude of 19,500 feet, the record for hydro-airplanes. Four passengers were carried during the flight, which was made to demonstrate carrying capacity rather than to determine the "ceiling" of the plane.

While the record is not remarkable compared with that of land planes with their present record of 40,800 feet, it is a noteworthy performance in view of the fact that passengers were carried. Furthermore, the record was made without the use of superchargers and oxygen tanks usually considered essential in high-altitude work.

Since the altitude record was made, this plane has flown from Philadelphia to New York with four passengers at a speed of 171 miles an hour.

Every-Day Wonders

Ten Questions about Familiar Things—Can You Answer Them?

EACH month Popular Science Monthly publishes ten interesting questions that sound simple and easy for anybody to answer. But *are* they? See whether you really know the scientific secrets back of these wonders of your daily life. Follow this feature regularly and you will find yourself picking up a great fund of useful and fascinating information about the world around you—the sort of knowledge, in fact, that makes for greater success in life.

1. Why is it easy to drink from a bottle through a narrow straw?

2. What happens when a fuse "blows"?

3. Why does the alcohol that you put in your automobile radiator in winter produce the desired effect?

4. How does a doctor's thermometer work?

5. What makes a person farsighted?

6. Why is foam white?

7. What instrument is used instead of the ordinary compass in a submarine?

8. What is air composed of? How much air does the average person breathe in one minute?

9. What are the essentials in a good tooth-powder or -paste?

10. Of what substance is a photographic film made? What happens to it when a picture is taken?

Answers to these questions appear below

Take Five Minutes a Day to Master These A-B-C's of Science

Drinking with a Straw

1. When a narrow straw is inserted into a bottle and suction is applied to the end of the straw, the atmosphere at fifteen pounds pressure to the square inch forces the liquid *outside* the straw down and then up into the partial vacuum created *inside* the straw, thus producing a steady flow.

Why Fuses Blow

2. When an electric current flows through a wire it makes the wire warm. Different materials resist the flow to different extents and are accordingly heated to different degrees. Fuse-wire is made of an alloy containing a large proportion of lead, which gets very warm when large currents pass through it. Furthermore, since this alloy melts easily, the current, if large enough, may cause the fuse-wire to melt.

Wherever current is being consumed in the house or factory, a piece of fuse-wire is put somewhere in the circuit. If through accident or design too much current should be used, the fuse-wire will melt, or, as it is usually described, "blow," and stop the flow of current before the copper wire inside the walls can heat up and set fire to the house.

Alcohol in the Radiator

3. Water freezes at 32° F. But alcohol does not freeze until −202° F. is reached. By mixing alcohol with the water the freezing temperature of the mixture is considerably reduced.

What Is a Clinical Thermometer?

4. A doctor's clinical thermometer consists of a thin stem of glass with a capillary opening throughout its length, sealed at one end and terminating at the other end in a bulb filled with mercury.

The action of the medical thermometer, like the household thermometer, is based upon the principle of the expansion of mercury when heated.

The tube of the clinical thermometer is usually restricted near the bottom so as to impede the return flow of the mercury column. This is done to give sufficient time to make the reading.

Cause of Farsightedness

5. Farsightedness is caused by an abnormal flatness of the lens of the eye or a defect of the eyeball that increases the focal length of the lens and causes parallel rays from a distant object to come to a focus beyond the retina.

Why Is Foam White?

6. Foam when examined through a lens or microscope, appears to be a mass of small bubbles. Now picture to yourself thousands and thousands of tiny water bubbles all throwing the rays of light back from their surfaces till the rays diffuse. The result is an appearance of white.

It should be understood that only when viewed in white light will foam appear white. If viewed in blue or green light, the foam would look blue or green respectively.

Chart the Ancestry of Your Children

TO what extent are the lives of your children—their mental and physical inheritance—influenced by their progenitors?

Bring out the family album! The quaint portraits hidden there can be combined into a picture-chart of the children's ancestry. Turn to page 67 and study the genetic chart of Alexander Graham Bell's three grandchildren.

Compasses in Submarines

7. Gyro compasses are used in submarines in place of the usual magnetic compasses. This change is made necessary because of the action upon magnetic compasses of near-by masses of metal.

A gyro compass is really a spinning top of large mass that starts rotating with its axis pointing toward true north. Due to the tendency of spinning bodies to maintain their axis of rotation unaffected by external forces, the gyro compass is not affected by metallic objects or by motion.

Composition of Air

8. Air consists of a mixture of various gases in the usual proportion of one part of oxygen to about four parts of nitrogen. It also contains small quantities of argon, helium, and other rare gases, carbon dioxide, aqueous vapor, nitric acid, ammonia, ozone, etc.

The average person breathes between 18 and 20 times a minute, inhaling at each breath-taking about 20 cubic inches of air.

Essentials of Good Tooth-Paste

9. Good tooth-powder or tooth-paste should be antiseptic and slightly alkaline. For daily use, chalk powder free from grit is preferable. For the removal of accumulations of tartar, fine pumice may be used. The antiseptic—boric acid, sodium perborate if of powder, and listerine, etc., if of paste—should not irritate.

Making Photographic Films

10. A photographic film is made of camphor, cotton, and acids that are combined to form a celluloid strip. On this strip is spread a layer of sensitive material, usually silver bromide or chloride.

As the picture is taken, the light reflected from the objects in the field of the lens strikes the sensitized surface and oxidizes the silver compound. When the exposed strip is immersed in the proper chemicals for development, the portions that were affected by the light turn dark.

How to Find Whether You Have a Movie Face

From their wide experience with thousands of persons, motion-picture directors have discovered that certain rules of facial proportion are essential if the actress is to photograph successfully in her film career

At the left an applicant is being measured to see if the distance between her eyes is exactly equal to one eye, as it should be. The distance from the point of the chin to the base of the nose must equal the distance from the tip of the nose to a point exactly between the eyebrows

As measured with a triangle and rule, the nose should not protrude more than three fourths of an inch from the face

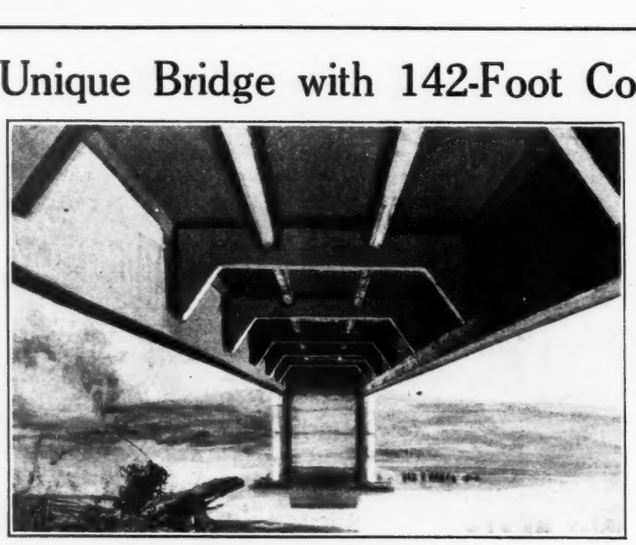
The mouth when smiling or laughing should never be more than a fifth larger than the mouth in repose. This "before and after" calculation is made with calipers

The lines formed by both sides of the chin should form an obtuse angle when viewed from a point directly in front

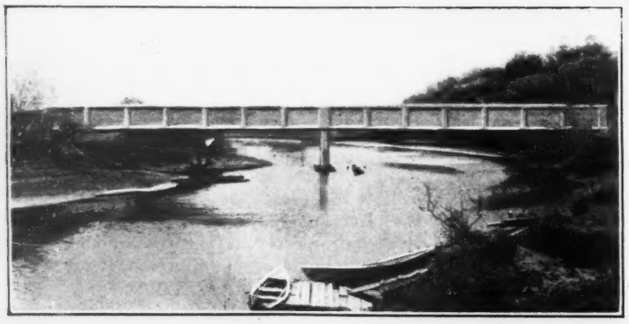
California Has Unique Bridge with 142-Foot Concrete Girders

A BRIDGE crossing the Salt River in California has perhaps nabbed the record for the longest stretch of concrete girders between supports, with its measurement of 142 feet between the centers. The girder type of bridge was constructed at this point because of the greater clearance and lower cost, also because the salt fogs coming from the Pacific in this region would destroy steel construction.

Each span consists of two girders twelve feet in depth. These girders carry floor-beams at twenty-inch intervals, and between the floor-beams five inches of concrete is carried on nine by twenty inch reenforced concrete stringers. These stringers are placed at the third point of the floor-beams. Main sections of the girder are seven inches thick and enlarge to twenty-four inches at the top and eighteen inches at the bottom. Pilasters opposite the floor-beams step up to a maximum width of thirty inches, with a thickness of eighteen inches. The steel is continuous over the center pier and no expansion joint is provided there.



Above: The under construction of the bridge showing floor beams and stringers



Left: The bridge as viewed from a distance. After the forms were set, it required but eight days to pour all the concrete for the entire structure

Whirling Germs from Water

GERMS weigh very little. Fifty billion bacteria of average size weigh about as much as a common pin, but if it were possible to weigh a solid mass of germs, they would weigh more than water.

Advantage is taken of this fact in separating germs from culture media in preparing antitoxins. Any filter small enough to keep back the germs would barely pass the liquid in which they live, but by using a centrifugal machine the germs can be readily collected.

Automobile Operates Traveling Merry-Go-Round

TWO young machinists who have turned showmen—Messrs. Bloom and Hicks—have devised an ingenious automobile drive for the traveling merry-go-round.

After they are through with their automobile for transportation purposes, the boys set their car on an improvised wooden jack so that the rear wheels are completely clear of the ground. This jack contains a reduction gear countershaft with two large

Merry-go-round is driven from motor-car

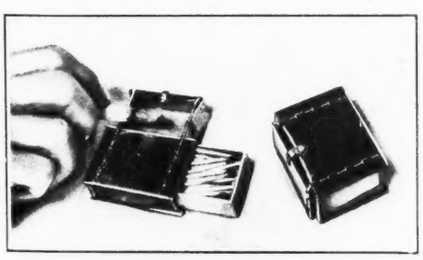
motor-truck sprocket wheels fastened to the extremities of the shaft, one at each outer end. A chain is run between these and two small sprockets permanently fastened on to the hubs of the two rear wheels.

The car is anchored to a stake by a turnbuckle and stay-bolts, thus enabling the operator to take up or let out slack in the transmission cable running from the car to the merry-go-round, this latter being placed about a grooved iron wheel attached to the outside of one of the large sprockets on the countershaft.

The machine is run in high gear all the time when at full speed, and is operated just as is done when driving along the highway.

When the engine is making about eight hundred revolutions, the merry-go-round is making its regular number of nine.

Matchbox Carries Ashtray



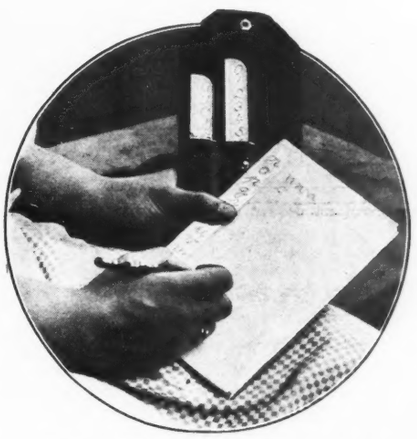
NO larger than the usual metal matchbox, this model has a little drawer that can be used as an ashtray. The sides are hinged so that they may be folded against the body of the box with the ashes inside, and emptied when an opportunity presents itself. The new matchbox, when closed, looks like a small book.

The device should appeal to the extremely neat and courteous smoker who does not like to scatter ashes on his hostess's carpet or over the upholstery of her limousine.

Cranks Propeller in Midair when Engine Dies

WHEN his motor stalled while he was flying two thousand feet in the air, Weseley May, a pilot of Long Beach, California, crawled out on the fuselage and cranked the propeller while his plane dived toward an apparently fatal crash.

This is the first time this feat has been accomplished. The picture shows the aviator demonstrating how it was done. If May had not been a man of unusual strength, it would have been impossible for him to turn over the engine from his insecure position astraddle the radiator, and it was very lucky for him that the propeller stopped in such a position that he was able to reach one of the blades.



Letter Strips of Aluminum Teach Children to Write

STRIPS of aluminum in which the letters of the script alphabet have been indented by a stamping machine make it easy for a child or an adult learning to write to obtain some preliminary practice in forming the letters without instruction.

The pupil follows the lines of the sunken letter with a pencil until the muscles of the fingers have become accustomed to make the movements necessary in writing. Then the aluminum strip is placed on the side of the pad, where its letters serve as a model.

Flash Removed from Gun-Fire

FLASHLESS gunpowder is one of the recent developments of the United States Ordnance Department.

Smokeless powder took away the telltale smoke and, ever since, ordnance experts have been working to get a flashless, smokeless powder. The success of their experiments is indicated by the report that guns as large as five inches have been fired at night with so little glow that observers standing twenty yards away could hardly notice it. It is said that sodium and potassium chloride are two of the chemical substances introduced into the powder to eliminate the flash.

An Advertising Owl

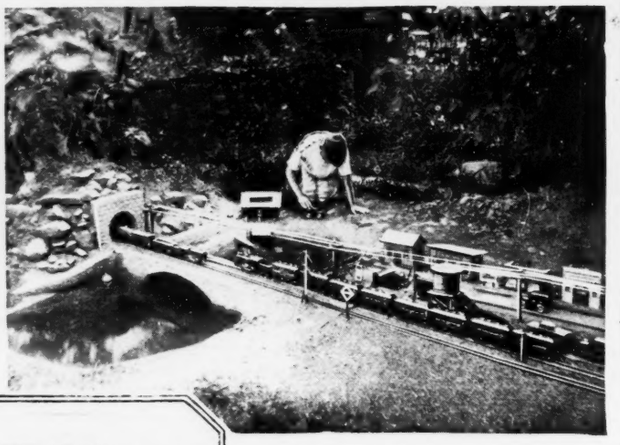
MADE to advertise the fact that a garage in Melrose, Massachusetts, keeps open all night, this mechanical owl can perform most of the acts of its live prototype. It can wink either or both eyes, turn its head as on a pivot, flap its wings, and wiggle its ears. It does all these movements by means of ropes and electric buttons.

A square wooden box was padded and covered with eiderdown cloth, which is expensive, but which made an excellent imitation of owl feathers. A smaller box was

A make-believe owl with illuminated eyes carries out the slogan "We never sleep"

placed on top and arranged to turn on a pivot. A board nailed to the back of the larger box was the means of giving a connection for the feet to rest on a perch. The eyes were made of automobile headlights. As completed, the bird is five feet high.

Every day it tours the town perched on a motor-truck over a sign reading "We never sleep."



© Kadel & Herbert

Ski-Car of the Alps Saves Strenuous Return Climb

COASTERS and skiers who like the trip down more than the exhausting walk back to the top of the hill, will appreciate this Swiss mountain trolley service. The trolley makes special trips at short intervals to carry the party to the top after every coast.

When the service was inaugurated, it was found difficult to bring the sleds and skis into the car, but the use of the trailer with its ski-racks solved that problem to the enthusiastic satisfaction of the tourists.

Our Mammoth Salt-Mines

LARGEST of the rock-salt deposits in the United States, and probably in the world, is the one that extends from northern Kansas across the west end of Oklahoma, the panhandle of Texas and southern New Mexico to western Texas. According to the geological survey of the Department of Interior these mines cover an area of approximately 100,000 square miles. The average thickness of the deposits is three hundred feet, but in some places the vein increases to seven hundred feet.

So large is the quantity of salt available in these layers that the present consumption of the United States, which is seven million tons annually, can be supplied for millions of years.

Santa Claus Dressed in a Wealth of Jewels

TO infuse his show-window with the proper Christmas spirit, a jeweler in Winnipeg, Canada, made up a Santa Claus and dressed the toy figure in the finest jewels in stock.

Santa's coat was made of rubies, many of them extremely valuable. The trimmings were diamonds set off here and there by sapphires. A cap of rubies, lined with sapphires and trimmed with emeralds and pearls, completed the outfit.

It was computed that this little figure, standing only eight inches high, represented a value in precious stones of considerably more than thirty thousand dollars.

Eight-inch Santa Claus dressed in jewels valued at over $30,000

Swiss "Samichlaus" Wears a Unique Costume

IN the quaint little town of St. Gallen, Switzerland, which has retained many of its curious medieval customs, Santa Claus makes his visits ringing a gigantic cowbell. The children would not recognize St. Nicholas in the red robe and long white whiskers dear to the hearts of youngsters in other lands. In St. Gallen, every Christmas Eve twelve men array themselves in white trousers and shirts, embroidered wool suspenders, and bright red ties. Each one fastens an enormous cowbell on to a wide leather belt, and covers his head with an enormous mask of cardboard, the upper part of which is decorated by stencilled designs.

One of the twelve is called "Samichlaus." It is his duty to give the good children their presents. The other eleven remain at a little distance on the outskirts of the jolly crowd that follows them on their rounds, giving candy to the grown-ups and entertaining everybody with their clowning.

Perfection of Detail Shown in This Boy's Railroad

BY building an outdoor toy railroad in his backyard, Clyde Nolan, a youngster of Elkhart, Indiana, started a profitable business campaign. His railroad is a real transportation system on a small scale. Its bridges, tunnels, way stations, turns, and terminals were all built with his own hands around a nucleus of the standard electric railroad track usually confined to the front parlor in the days just after Christmas. Even the lake is his own idea, dug by himself, and he is proud of the fact that real goldfish live in it.

Everything about this railroad has been built to scale, and constructed in perfect detail.

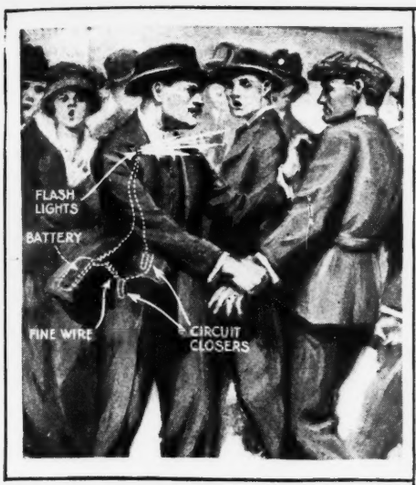
BALSA, the lightest wood known, has 90 per cent of its volume composed of air enclosed in large, barrel-shaped cells. This large amount of non-circulating air make it ideal for refrigerator insulation on shipboard. It is also strong.

Measures Height and Weight

A PORTABLE weighing-scale and height-measuring instrument that can be taken apart and packed in a small suitcase has been invented by M. J. Weber, of Chicago, for the convenience of visiting nurses doing district work.

The instrument has a balance lever with markings that can be read by a person standing either in front of the instrument or at the rear. This arrangement is entirely novel. Such markings are usually arranged for reading by the person on the scale. The height-measuring device consists of two simple telescopic members the reading of which always appears at a fixed point. These members are readily detached from the main standard of the apparatus when it is to be packed to carry from house to house.

These scales can be packed in a suitcase



Alarm Attached to the Coat Will Warn of Pickpockets

TO catch the criminal whose fingers are too light to be detected in action, an inventor has perfected an electric alarm to be attached to the coat. A tiny dry cell hangs conveniently in the coat lining with fine wires leading to all coat and trousers pockets. These wires are sewn into the cloth so that their presence would never be detected.

The wires of all pocket circuits lead to a small metal rosette worn in the lapel buttonhole. It contains four little colored electric lights, each about the size of a small pea.

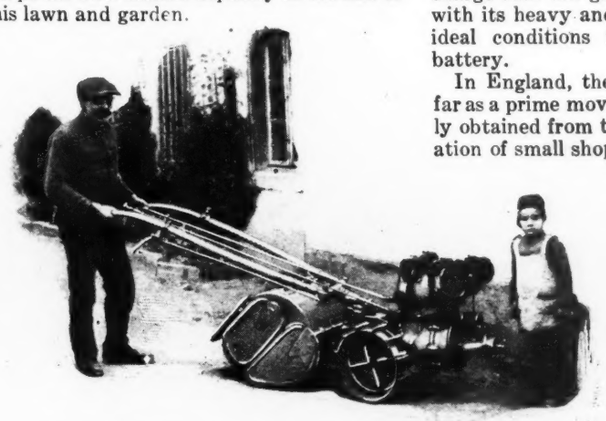
If an alien hand is thrust into one of the pockets thus protected, the circuit is closed and the lights in the lapel flash.

VERY rarely do we hear thunder from a clear sky. Such sounds usually come from blasting, but now and then the thunder is produced by the rumblings of earthquakes too feeble to be felt.

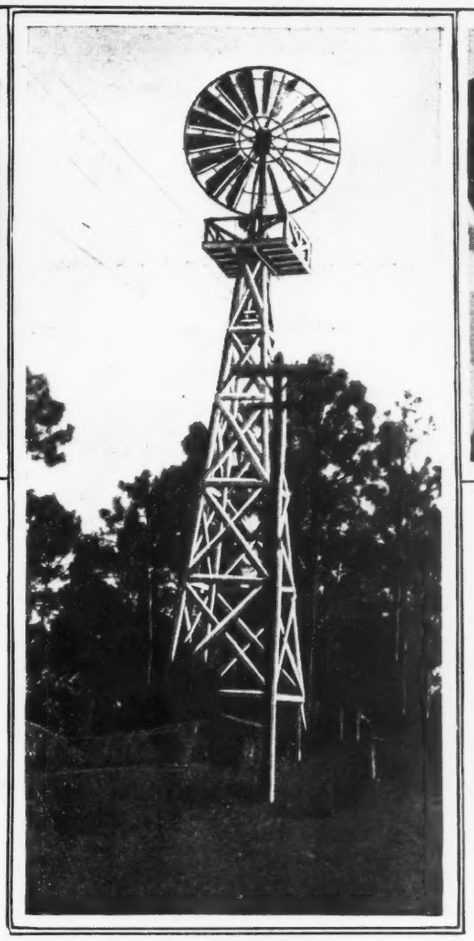
Cultivator Runs Dairy when Off Duty

EQUIPPED with a one half to one horsepower gasoline engine this invention cuts the lawn and packs the mown grass into a light metal box; it plows; it supplies a portable power plant for churning, feed-cutting, sawing, pumping, etc.

On one of the two guiding handles are the controls for starting, stopping, high speed and for disconnecting the gears so that the mower may be man-driven, if desired. Altogether it is an ideal tool for the suburbanite or vacation farmer who oversteps his own muscle capacity in the size of his lawn and garden.



After cultivating the fields, this cultivator can be used to drive pumps, saws, dairy appliances, and other tools



Getting Electricity from the Windmill

FROM a novel windmill generator, A. I. Root, of Medina, Ohio, is getting sufficient current to charge the battery of his electric automobile, to light his house, and to run a small electric stove.

Instead of gears to multiply the speed of the generator, a belt runs from the periphery of the sixteen-foot wheel of the windmill to the pulley of the generator. To provide for varying weather conditions, an idler is used to take up the slack of the belt. The generator itself is mounted on a revolving platform so that it moves with the wheel as the wind shifts.

The current is automatically disconnected when the speed of the mill is too low to store the battery. This arrangement prevents any danger of changing the polarity of the battery or backward discharge into the generator. The windmill, with its heavy and light charges, provides ideal conditions for charging a storage battery.

In England, the windmill has advanced far as a prime mover and power is frequently obtained from the air for the entire operation of small shops.

Testing the Heart of the Telegraph-Pole

CHESTNUT telegraph-poles have a habit of rotting off at the ground line, and public service corporations cannot afford to renew them until there is a real possibility that the pole will break off. It is the duty of George Goeb, of Baltimore, to see that the poles do duty as long as possible, but never actually fall.

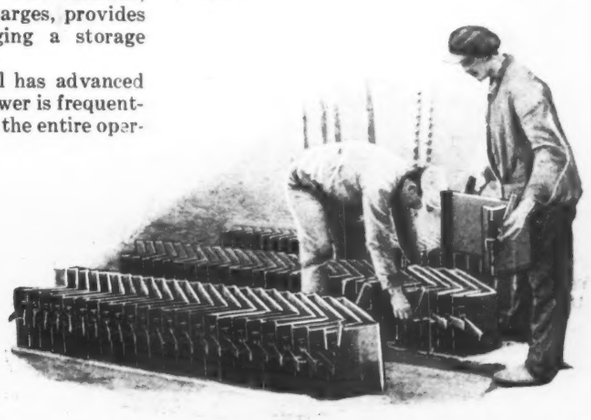
His tools consist of a brace and bit, a quantity of wooden pins, a hammer, and a large amount of experience and judgment. He goes from pole to pole boring a hole at the ground line and from the condition of the chips he decides how long the pole is likely to last. He visits every pole in the city of Baltimore once every two years.

AFRICAN teak is the heaviest and stronger wood known, exceeding lignum vitæ in both respects.

How Concrete Bricks Can Be Cast at Home

A QUICK-ACTION mold for making thirty or more double cement bricks at a time is proving so popular abroad that communities have bought the appliance for the benefit of their home-builders.

To eight parts of sand, gravel, cinders, or slag, one part of cement is mixed. This is poured into the locked mold and tamped down. When forty minutes have elapsed, the pins and hooks of each of the right-angle walls of the mold are released and the bricks left on a wooden base to dry. The bricks are doubles, connected at right angles, which helps to lock them when they are laid.

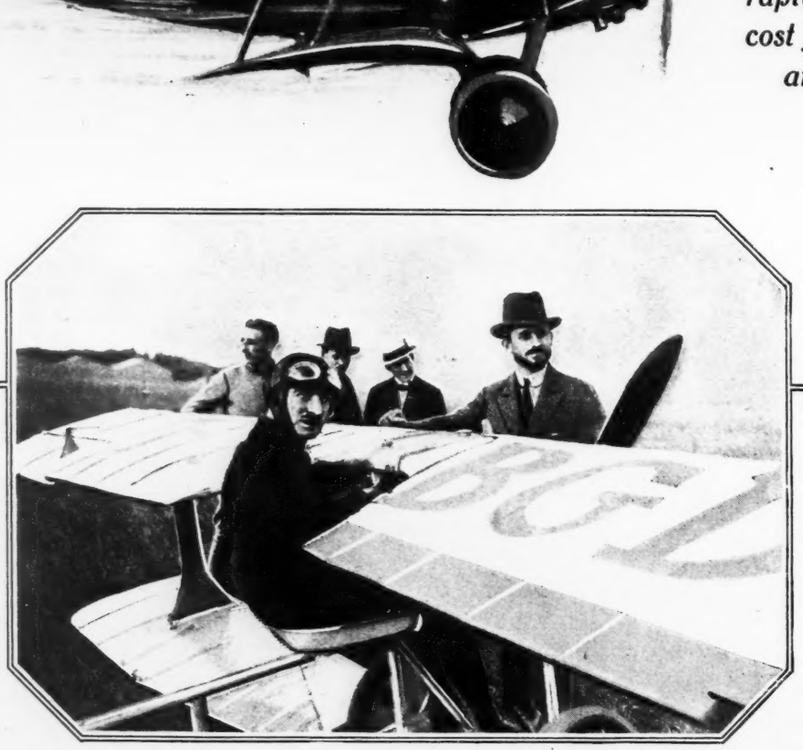


Thirty double cement blocks a minute can be made with these quick-action molds

The Day of the Air Flivver Has Dawned

Here are the latest baby planes designed to provide rapid transit at low cost for business men and sportsmen

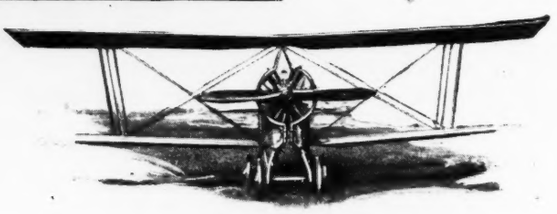
Weighing only 652 pounds, with a wing spread of twenty feet and a height of seven feet, this single-passenger plane can be driven ninety miles an hour on a gasoline consumption of only four and one half gallons



Baby planes cost little more than a good motor-car and are no more expensive to operate. They attain a speed of one hundred or more miles an hour with a fuel consumption of three or four gallons

An air motorcyclette, so called, made in France, and driven by a sixteen-horsepower engine. The pilot sits unprotected in an open cockpit seat while the plane reels off its fifty-eight miles an hour

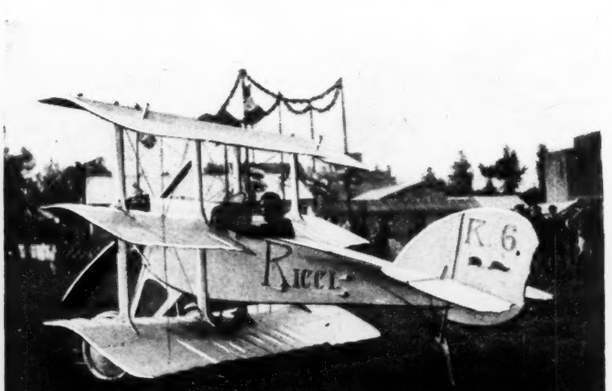
To make landings in confined spaces, baby planes are designed for low landing-speeds. This "airster," weighing six hundred pounds, has a landing-speed of only thirty miles an hour. One feature is its interchangeable wings



The baby plane above is unique in its four instead of two landing-wheels. All parts of the plane are constructed of the newly discovered metal, duralumin, which provides strength with lightness

Photos from W. M. Kellett

With a speed of from sixteen to eighty-seven miles an hour, this trim-looking plane is yet small enough to be handled by one man. It can take off or land in a fifty-yard field



The triplane pictured here is but sixteen feet wide and weighs only 440 pounds. In spite of its small dimensions it has a maximum speed of ninety-two miles an hour

Architect Predicts Pyramid Cities for America

"BACK to the style of the pyramids" is soon to be the motto of architects who plan American skyscrapers, according to one of the most noted among them, Harvey W. Corbett, co-designer of the beautiful Bush Terminal Building in New York City.

A forecast of the weirdly artistic, mountainous skylines of future American cities is already to be seen in several buildings lately constructed in Manhattan.

When the United States supports the 500,000,000 inhabitants predicted by statisticians, and our cities have become more vast and crowded than they are now, it will be more necessary than ever to build skyscrapers so that light and air can reach office-workers and people in the streets below.

Already laws passed in some cities require that the upper stories of all such buildings shall have "set-backs" at an angle determined by each particular section of a city. This angle is found by drawing an imaginary line from the center of the street to the height allowed the first "terrace" in that building zone. All other stories added to the structure must not extend beyond that line. Suppose, for instance, that the street is one hundred feet in width, and building laws require that no building shall be higher than the street is wide, unless the front is terraced. Then the diagonal line of an imaginary triangle constructed with a base of fifty feet and a vertical leg of one hundred feet, would dictate the slope of the pyramidal front.

Babylon's Hanging Gardens Revived

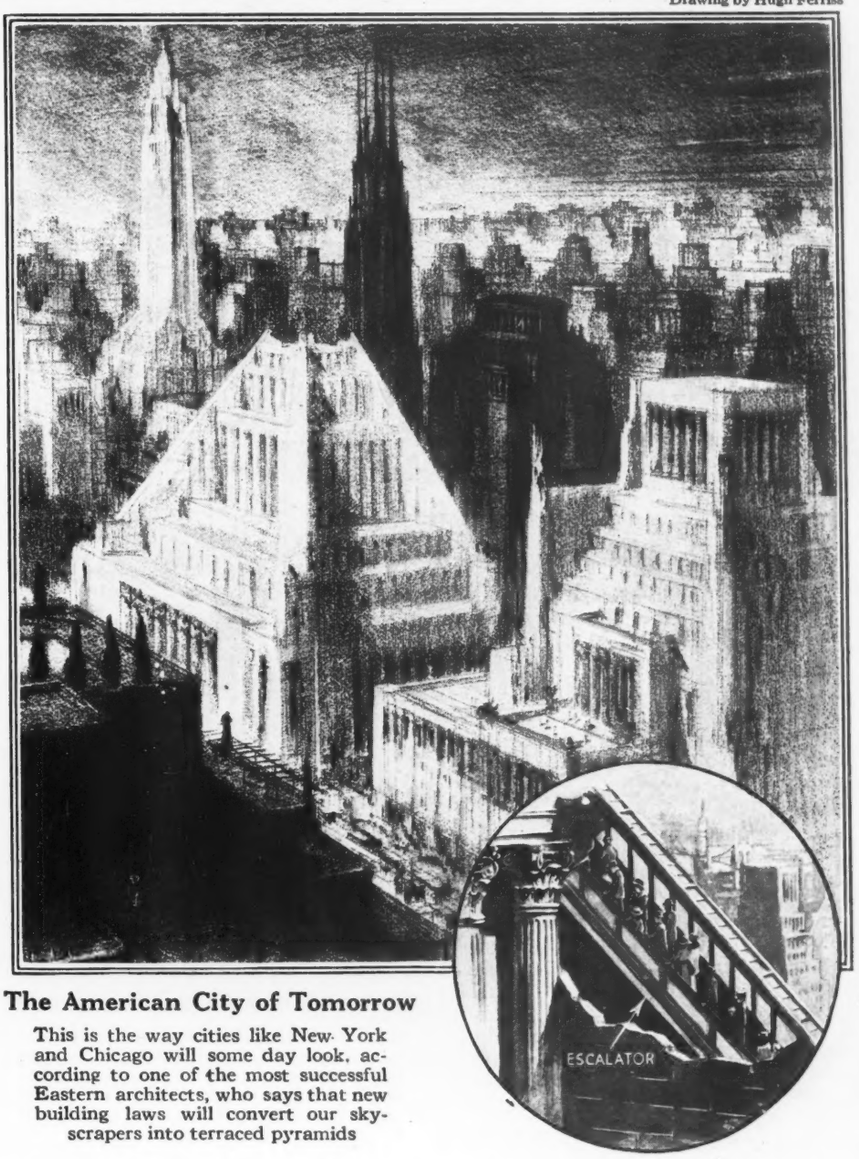
It will be seen, therefore, that in cities having many high buildings, the latter will mount step by step, always receding from the street. Quoting Mr. Corbett, "These aerial terraces will suggest the construction of roof-gardens, tennis-courts in the clouds, open-air theaters, Greek temples in the sky, and green terraces encircling apartment-houses. New York, Chicago, San Francisco, and other great cities will look like Babylon with its hanging gardens."

Architects are now picturing the probability of each city block being taken up with an enormous pyramid of marble, granite, or terra cotta. In the immense buttresses at the corners, defining the lines of the edifice, would run escalators that would take the place of the usual elevators.

"These radical changes are not so far-fetched as they may at first seem," Mr. Corbett remarks. "Equally as phenomenal architectural changes have come in the past twenty years. Scarcely a well-known building standing in New York to-day was here twenty years ago. Even modern skyscrapers are sacrificed to the movement of business, and a significant thing about twentieth-century architecture in this country is that it is not meant to be permanent.

"I believe that American cities will gain in architectural harmony, and that our business districts will be far more restful to the eye and nerves as a result of the uniform height of the terraced structures that, I predict, will become familiar in every metropolis."

Drawing by Hugh Ferriss



The American City of Tomorrow

This is the way cities like New York and Chicago will some day look, according to one of the most successful Eastern architects, who says that new building laws will convert our skyscrapers into terraced pyramids

In the sloping corners of future skyscrapers there will be escalators supplementing elevator service

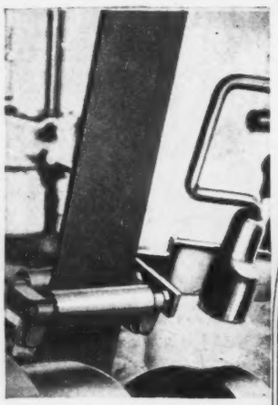
Trenching Machine Digs to Exact Level

THIS miniature trenching machine excavates the ground to the exact depth required, permitting the forms for concrete roads to be set accurately to the specified grade in about one tenth of the time required when the work is done by pick and shovel. It has been designed to avoid loosening the dirt below the point at which the bottom of the form should rest, since if the form is set on an unstable foundation, it sinks when the concrete is spread, making the surface of the finished road uneven.

The grader is designed to excavate a trench eight inches wide. A five-horsepower gasoline engine drives a cut-steel sprocket by a roller chain that has an automatic spring idler chain take up. Four digger blades of tempered tool steel are moved down as they wear so that sharpening is unnecessary.

The cutter is raised or lowered by turning the automobile type steering-wheel. To cut exactly to grade, a guide-line is stretched one foot out from and one foot above the place for the bottom of the form. As long as a gage-point on the grader is kept level with the grade line, the cutter will excavate to exactly the required depth. Thus, by raising and lowering the cutter, the bottom of the small trench is cut accurately to grade regardless of irregularities in the surface over which the machine travels. The digger excavates from three hundred to seven hundred feet of trench an hour.

This trenching machine will cut a ditch to exact depth in one tenth time required by hand labor



Shifts Belts without Danger of Injury

A NEW attachment for heavy machines where belts must be shifted frequently performs that action instantly and without danger to the operator.

In the illustration above, the handle with which the attachment is operated is shown at the extreme right; the rolls through which the belt travels and which form the lower bearing surface at the lower left.

When the speed is to be changed, the handle is turned. This twists the lower roller in one direction and a second roller near the upper shaft in the opposite direction. The combination of twists causes the belt at jack-shaft and machine to assume the new positions.

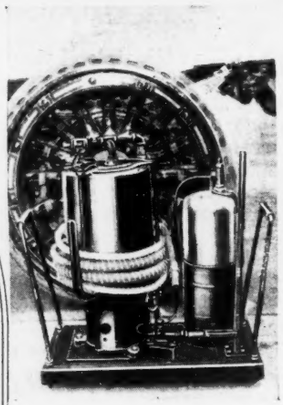
STEEL derricks are replacing the wooden oil-rigs in California's petroleum fields.

How Freight-Car Tests Airplane Flight

WING strains and propeller stress on an airplane in flight are measured with this aerodynamical testing-plant.

A plane of any model can be fastened to the top of the lattice-work tower, which is rigidly bolted by the freight-car. The car is drawn by a locomotive at speeds up to thirty-seven miles an hour, which, although considerably less than the average flying speed of the plane, is sufficiently fast to allow accurate data to be secured on the strains borne by the plane while flying. The connection between the plane and the top of the tower is made through hydraulic dynamometers.

With this equipment more accurate data has been obtained on the lift, stability, and air resistance of airplanes than was possible with the use of small-scale models in wind-tunnels.



It Thaws Hydrants with Gas

FROZEN hydrants may be thawed by steam produced by this apparatus within twenty seconds of the time it is lighted. A steam coil is surrounded by a jacket tank filled with water, which is forced into the coils by a hand pump. By regulating the speed of pumping, either wet or superheated steam may be produced. Heat is supplied by burning acetylene gas contained in the tank at the right.

The steam is led through fifteen feet of flexible metallic hose protected by a braided steel jacket. To safeguard the operator from burns, half the length of this hose is covered by an asbestos wrapping. The device weighs only 135 pounds, so that it may be quickly carried to a hydrant in any emergency that might arise.

Daughter and Dad Can Use Adaptable Novelty

LITTLE daughter insists that it is a scooter; Dad remembers that the handle is in two parts that form an admirable shooting-seat when separated. Both agree that it is constructed entirely of aluminum, weighs only four pounds, and folds up into a proper walking-stick when it is necessary to carry it to the beach or the shooting-field.

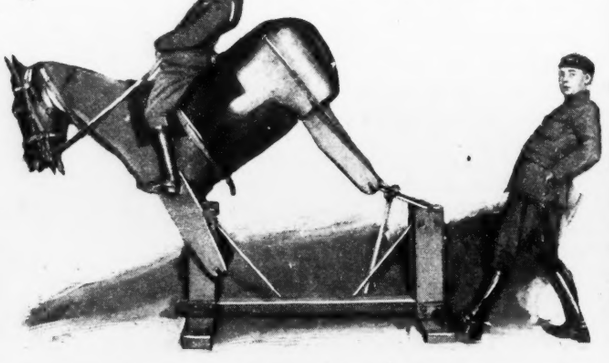
© Kadel & Herbert

The scooter folds up into a shooting-seat or into a walking-stick, according to the whim of the user

Hobby-Horse Teaches Soldiers to Ride

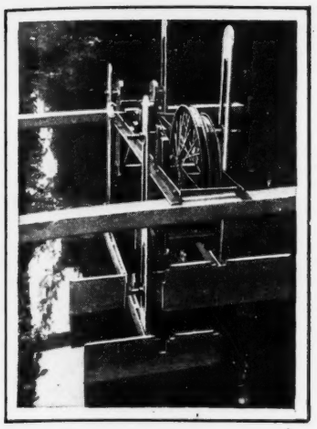
HOBBY-HORSES of wood are used in England to teach soldiers of a Territorial regiment the elements of horsemanship. It is no nursery animal, however, for springs and levers make the animal buck, gallop, and even jump over fences.

The rider is learning how to keep his seat when his mount leaps over a five-barred gate. No stirrups are used, since the object of the instruction is to develop a sense of balance and ease in the saddle.



Cavalry recruits are put through their paces on this mechanical horse, which can buck, gallop, or hurdle

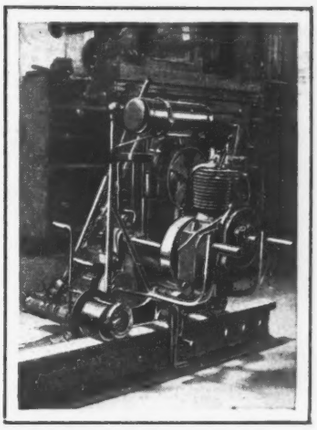
As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly



Armored Car Chases Auto Bandits

THE motor-bandit chaser of the Denver, Colorado, police force consists of a high-grade touring-car engine and chassis, upon which has been mounted a special body. It can make seventy miles an hour on the average road, the frame being specially reenforced. The sides, hood, and radiator are protected by bullet-proof steel. It has no top or doors. It carries six officers, one of whom—the driver—is protected by a half wind-shield of bullet-proof glass.

The car has bucket seats, the rear seats having a slight elevation over those in front, enabling the officers behind to shoot over their heads. The rounded fender and T-rail along the sides are for the purpose of crowding a bandit car into a ditch.



The features of the car are bullet-proof armor-plate, spotlights, machine gun, bell, siren, and T-rail for crowding cars

Walking Watermill Hydraulic Novelty

IN this water "auto-ped," paddles are carried downstream by the current, lifted from the stream by the flywheel, and moved back through the air, dropping into the water again at the original point of impact. The motion of these reciprocating paddles is transmitted to driving cranks. The machine utilizes the energy of a shallow stream of moderate flow without requiring the construction of dams or weirs.

In spite of the ingenuity of this invention, it is doubtful if it will replace the old-fashioned undershot water-wheel. Both operate on the same principle, and the power lost in moving the blades upstream is almost certainly greater in a reciprocal device.

Drills Rails for Bonding Wire

ABOVE is shown a machine that is self contained, having a four-cycle gasoline engine with magneto in crank-case, its weight being 160 pounds.

It will drill a three-eighth-inch hole through the web of the rail in fifteen seconds, and on the approach of a train it can be removed in less than two seconds by one man. It has all necessary adjustments of height and rate of feed. One lever brings the drill to the drilling-point and another lever picks up the drill and feeds it through the rail. It can be rolled along the track from one joint to another with little effort.

LIQUEFIED carbonic acid gas is often found in the interior of sapphires.

Have You Tried Chuting the Pig?

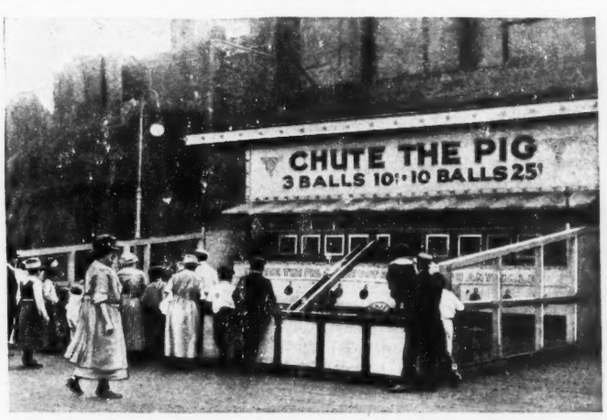
USING one's accuracy of arm and sense of direction to liberate an active pig, who then slides down a chute, forms one of the most successful of the season's amusements.

If one is able to hurl a baseball through one of the holes beneath the pens, the ball strikes a paddle, loosens a trigger, a door flies open, the occupant emerges and slides down the chute. He lands on a cushion, jumps down quickly, and rushes back through a doorway.

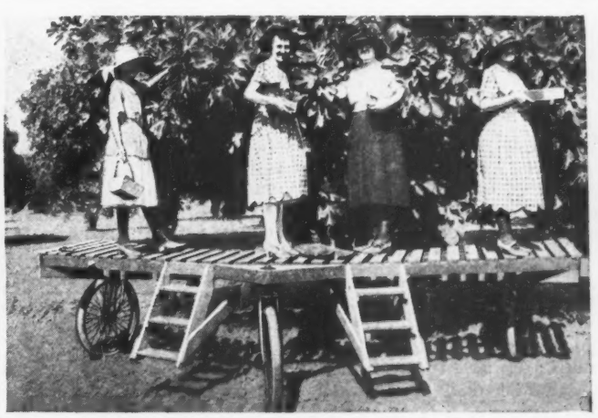
Fig-Picking Stand Travels on Wheels

FOUND among the devices used by fig-growers in the great fig district of California is this portable picking-stand.

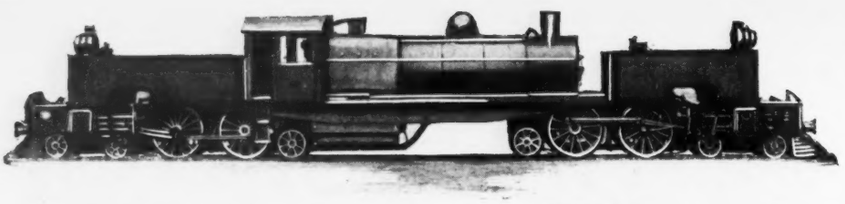
Where feminine labor is depended upon to a considerable extent, the use of cumbersome ladders is not feasible. These stands-on-wheels accomplish the same purpose, but with greater comfort and security to the workers. The platform is made in the form of a triangle with a rubber-tired bicycle wheel under each corner and with steps leading from the ground.



By hurling a ball through a hole, a pig is released to slide down the chute



A triangular stand supported on three wheels provides a comfortable, easily moved platform for fig-pickers



Double Tractive Equipment on This Locomotive

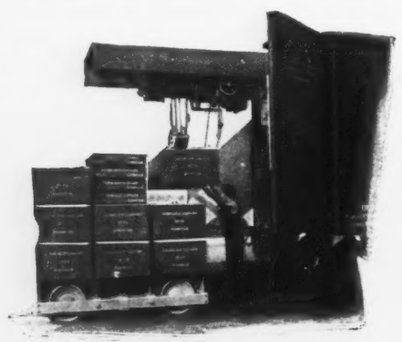
BOTH ends of this passenger locomotive have been equipped with steam cylinders and driving-wheels. This feature, aided by the unusual length of the engine, gives it an increased tractive power. Steam is supplied to both driving-wheels from the same boiler, which is supported on two heavy steel girders extending between the tenders.

A turntable is not necessary with this locomotive, as it will haul a train attached to either end with equal facility.

Weights to Test Master Scales Throughout Country

A DEPOT in Chicago for housing the master track-scale equipment and for testing cars of all railroads entering the Windy City is being urgently advocated by the national Bureau of Standards.

The master track-scale here illustrated would be installed in the contemplated station for the standardization of test cars. These cars, of which two are already in service, carry 200,000 pounds of test weights that are employed in certifying to the accuracy of every master scale in the United States. The weights are divided into sections of 10,000 pounds or five tons each.



A special car equipped with cranes for handling the heavy weights goes about the country checking scales

The master track-scale is not remote from the life of the average citizen, for upon its accuracy depends the price of beefsteak and other food products. That those in use need calibration, is indicated by the fact that the Bureau of Standards has found discrepancies in 50 per cent of the number thus far inspected.

Cement Blocks Equal Clay Bricks in Strength

SOLELY with the intention of deciding once and for all the relative strengths of the many types of cement and concrete blocks used for building purposes, as compared with the old clay brick, a series of experiments has been carried out at Columbia University by the committee on tests.

The tests completed to date indicate that the strength of masonry structures built of cement blocks is greater than those built of clay, although it is admitted that the material entering into the making of bricks has a great deal to do with their final efficiency.

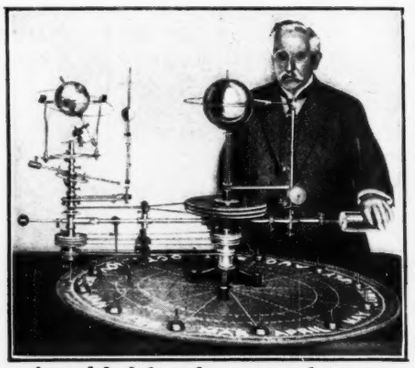
It is probable that the results of the experiments will call for the revision of building codes throughout the country.

Can-Opener and Pourer for Powdered Milk

THE two pointed ends of this device are driven into the can up to the flange. Desiccated milk, or any other powdered substance, can then be poured cleanly out of the spout. A little tin cap closes the hole and prevents the contents of the can from becoming contaminated by dust or dirt. This attachment is made of steel and should last indefinitely.

Working Model Demonstrates the Solar System

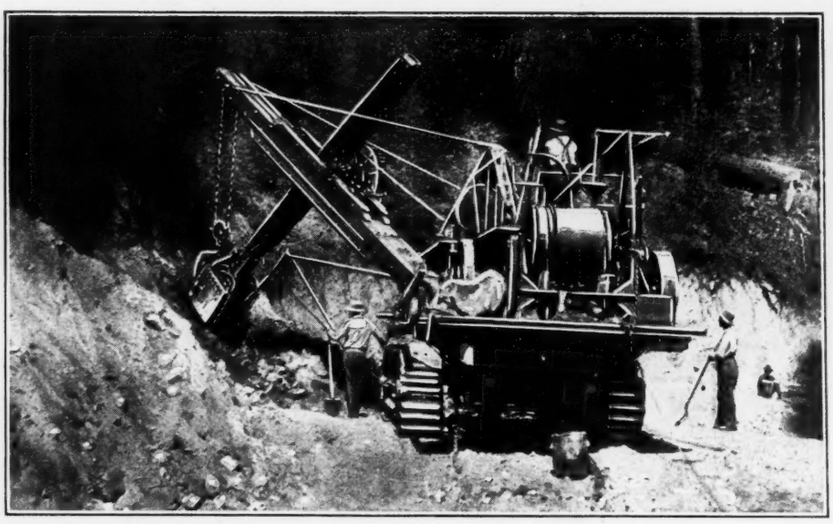
WITH the model designed and constructed by Dr. William Wilson, F.R.A.S., the movements of the sun, moon, and earth are demonstrated with mathematical accuracy. Motion of the hand lever makes all these heavenly bodies revolve in their orbits, so that students can readily be shown the more complicated and obscure relations between the movements of these bodies.



A model of the solar system that predicts eclipses and indicates position of heavenly bodies during any month

Pulleys of adjustable circumference and cords the tension of which may be regulated make the model extremely accurate. By its aid, it can be shown that the moon makes 13/39 revolutions in a year, 12/39 lunations annually, and that there are 223 lunations in the Saros cycle. This latter phenomenon was known to the ancient Chinese and Chaldean astronomers, and by means of it they predicted eclipses. It is a period of 18 years and 11 days which must elapse between the occurrence and recurrence of any eclipse. The retrograde motion of the nodes of the moon, which determine whether any eclipse will be partial or total, can also be shown; as well as the forward motion of the line of apsides, and other involved points.

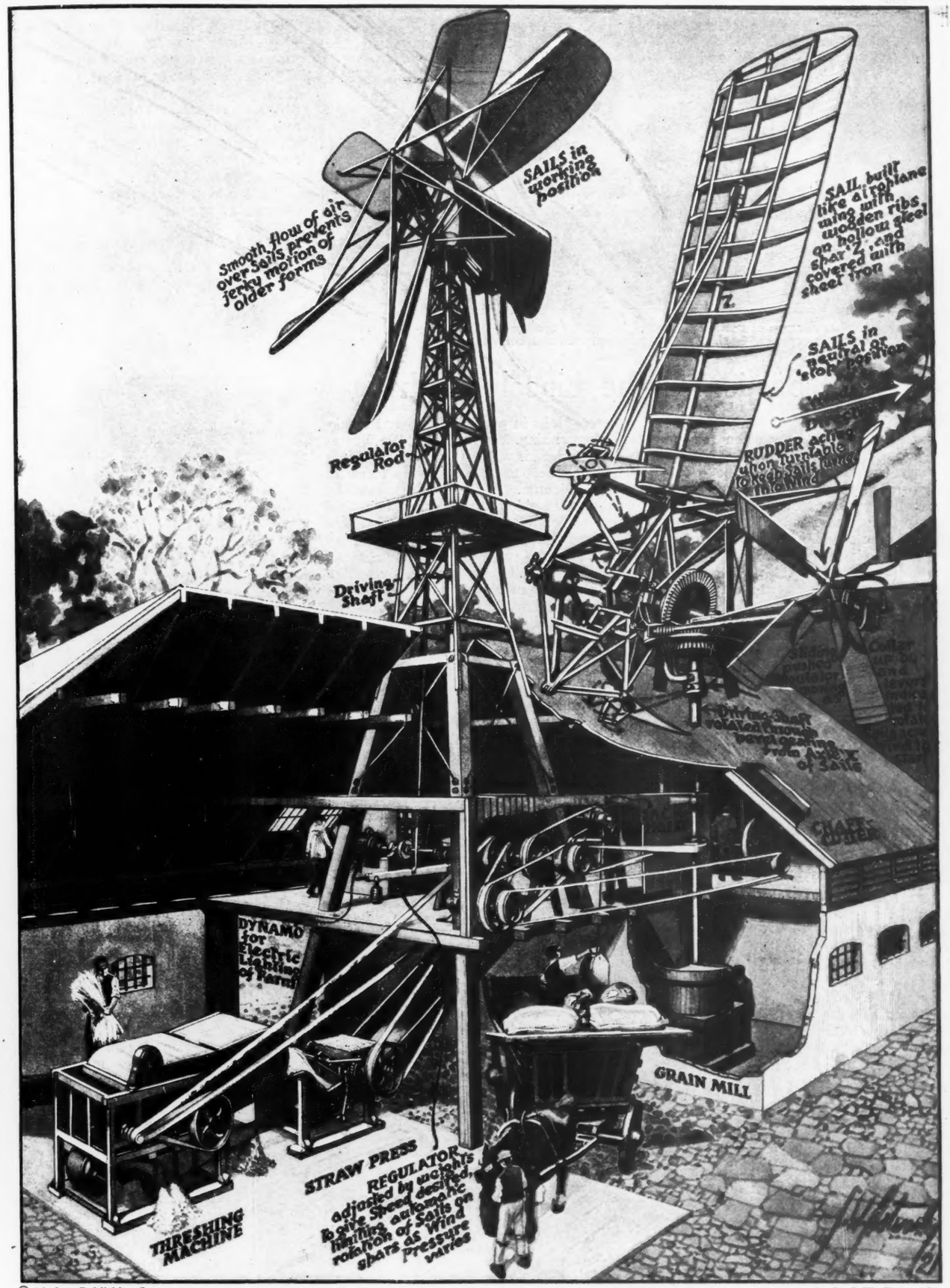
Outfit Equals Steam-Shovel and Fifteen Men



OF practical size and suitable for the vast majority of contracting jobs, a gasoline "steam-shovel" is shown constructing a logging railway. The shovel is gasoline propelled and operated. The scoop capacity is one half cubic yard, and the gas consumption thirty gallons a day.

An air-compressor is run in conjunction with the shovel if air is needed for drilling holes for blasts, and caterpillar traction has been adopted to enable the shovel to travel over rough ground and to obviate the necessity of track-laying. These two improvements, the operators claim, enable the gasoline shovel to do the work of a steam-shovel with a crew of fifteen men.

Windmill Blades Shaped Like Airplane Wings


SAILS in working position
Smooth flow of air over Sails prevents jerky motion of older forms
SAIL, built like airplane wing with wooden ribs on hollow steel spar, and covered with sheet iron
SAILS in neutral or "stop" position
Regulator Rod
Driving Shaft
RUDDER acting upon turntable to keep Sails turned into the Wind
Driving Shaft rotated through bevel gearing from Axle of Sails
CHAFF CUTTER
DYNAMO for Electric Lighting of Farm
GRAIN MILL
STRAW PRESS
REGULATOR adjusted by weights to give Sails desired lifting action, automatic rotation of Sails on shafts as Wind pressure varies
THRESHING MACHINE

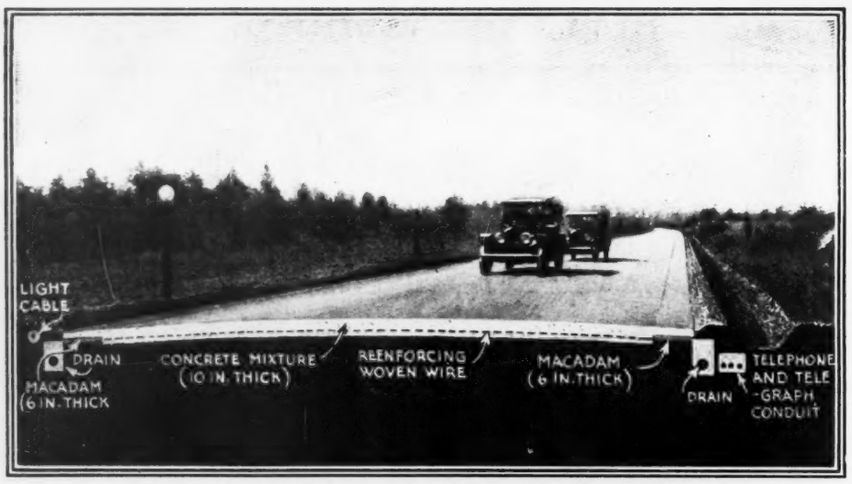
© Modern Publishing Company

Drawing by S. W. Clatworthy

TWO engineers, P. Vinding and R. J. Jensen, have used the knowledge gained by aeronautical experts to design a new type of windmill that is twice as efficient as the older type.

The inventors have produced blades made of sheet iron over wooden ribs that follow the contour of airplane wings. But perhaps their most noteworthy contribution is an automatic device that holds the wings into the wind and alters their angle as the wind pressure varies.

Details of the wings and controlling apparatus are shown in the upper right-hand corner. The first installation has been made on a farm in Denmark, where a threshing machine, straw-press, chaff-cutter, and sack-hoist are dependent upon the windmill for their operation



A cross section of the ideal road planned for the Lincoln Highway. It represents the latest in scientific road construction

An Ideal Section of the Lincoln Highway

WHAT is the perfect road? The Lincoln Highway Association has now launched a plan to build a mile of perfect roadway that shall embody the best of modern roadmaking practice, and serve as an example to be followed by roads constructed in the future.

As yet, the specifications are tentative, but the following points have been decided upon as necessary for the perfect road in level, farming country with open fields on each side:

The right of way must be one hundred feet wide, and provide for an average traffic of fifteen thousand passenger-cars at thirty-five miles and five thousand motor-trucks at an average speed of ten miles. The roadbed must be built of concrete ten inches thick, with reenforcing steel embedded. The steel is merely to hold the concrete slabs in place and prevent cracks from spreading. Submerged tile drains and catch-basins will replace the open ditch which in the past has been the cause of many accidents. Earth shoulders shall be used on each side of the concrete bed. No curve the radius of which is less than one thousand feet shall be allowed, and all curves shall be super-elevated for a speed of thirty-five miles an hour. Advertising signs shall be prohibited along the right of way, and as far as it is practicable obstructions to the vision within five hundred feet of a crossroads shall be eliminated.

In addition to these engineering specifications, the ideal road will be carefully and adequately lighted so that motorists may travel in the open country with dimmers on their headlights. And, finally, the ideal section will be fenced at all embankments.

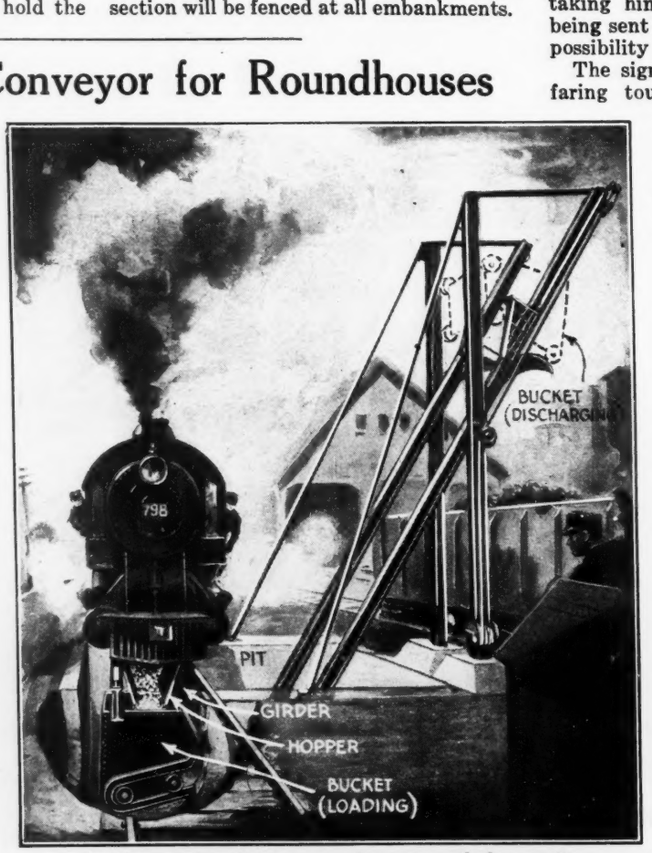
One-Man Ash-Conveyor for Roundhouses

ONE man and an electric motor move all the cinders from the locomotive roundhouse of the Norfolk & Western Railway to the cars that haul the ashes.

The cinders are dumped from the engine firebox to a cast-iron bucket holding eighty cubic feet, which is set at the bottom of a concrete-lined pocket built beneath the track. As soon as this bucket is filled, a twenty-horsepower electric motor hauls it up an inclined track at the rate of one hundred and fifty feet a minute. This track extends from the interior of the roundhouse to the tracks outside, and projects over the ash-car.

When the bucket reaches the top of the truck, the ashes are automatically dumped into a freight-car. The only man needed for this work is the winchman, who operates the electric hoist with a control handle, in much the same way that a motorman controls his car.

With this skip-hoist it requires but twenty minutes to bring in an engine, clean the fires, and send it out again.



As the engine drives over the pit and dumps its ashes, the man at the right operates the hoist that carries the ashes over to the ash-car

Sightseeing Bus Is Guided Like a Ship

MARINE signaling telegraphs, exactly similar to those used at sea to communicate between the bridge and the engine-room, have been installed on a gigantic sightseeing bus to inform the driver of all traffic approaching from the rear. The bus is built as nearly as possible to conform to the lines of a ship, and is called a land yacht. It carries thirty-two passengers.

The yacht is controlled by two marine telegraphs, one of which is used by the "skipper" or driver at the steering-wheel and the other by the "mate" at the stern.

A lever and dial like a ship's telegraph, conveys orders between chauffeur and conductor

The bus is so long and high that the driver cannot possibly see or hear vehicles overtaking him, but with signals constantly being sent him by the "mate," there is no possibility of accidents.

The signaling system also lends a seafaring touch to the bus. This idea is carried out by dressing the skipper and the mate in uniforms typical of officers of the merchant marine, and by flying the Red Ensign and a house flag over the bus.

Willow Holds Back the Mississippi

GREEN willows—the ordinary willow that grows alongside rivers and brooks—made into huge mats two hundred feet long and one hundred feet wide, are doing more toward holding the Mississippi River in its course than thousands of tons of stone and closely packed earth.

In making the mats, timber frames are constructed around the entire area of the mats, with cross pieces dividing the inside into small sections. Into these are placed the willow-trees and bushes that are later bound with heavy cables and towed to their destination. On arriving there, they are anchored over the spot to be protected and then covered with earth and broken stones until they sink.

Trawler Equipped with Odd Scientific Devices Sweeps Atlantic Bottom for Gold

Instruments Invented to Locate Submarines May Be Used to Find Two-Million-Dollar Treasure Ship

By Ralph P. Perry

GOLD! Gold coin for the taking, kegs of it; and twenty-one tons of bar silver. Two million dollars ready for the finders, if they can locate the spot where the ship *Merida* sank ten years ago and raise the treasure-trove from the sands two hundred feet beneath the surface. Members of the most picturesque deep-sea hunting expedition in recent history have been secretly braving the Atlantic on the little trawler *Ripple*, in search of this treasure. Among their number are Frank Crilley, world's champion deep-sea diver—who went down in three hundred feet of water to raise the submarine F4, off Honolulu—and Captain George W. Nordstrom, who was mate of the old *Merida* when she sank off the Virginia capes. These men are engaged in a contest of human courage and modern scientific instruments on one side, against the limitations of the art of navigation on the other.

How the "Merida" Was Wrecked

One expedition, in 1916, backed, it is said, by Percy Rockefeller and James A. Stillman, former president of the National City Bank, failed even to locate the *Merida*. For the position of a ship out of sight of land is never exactly known, and had it not been for Captain Nordstrom's remarkable courage in taking, at the time of the accident, the *Merida's* exact position, this new search would seem equally futile.

At twelve-thirty on the night of May 12, 1911, the *Merida* was rammed by the liner *Admiral Farragut*. She began to fill and sink. As soon as passengers and crew had been taken aboard the *Admiral Farragut*, Captain Robertson and Chief-Officer Nordstrom turned their attention to the gold. The *Merida* was sinking. What was their position?

They had steamed through the darkness for more than eight hours since the last observation of the sun. How many miles had she been carried off her course by the Gulf Stream as it swept to the northeastward? How far had she drifted toward the west before the stiff breeze and the choppy sea?

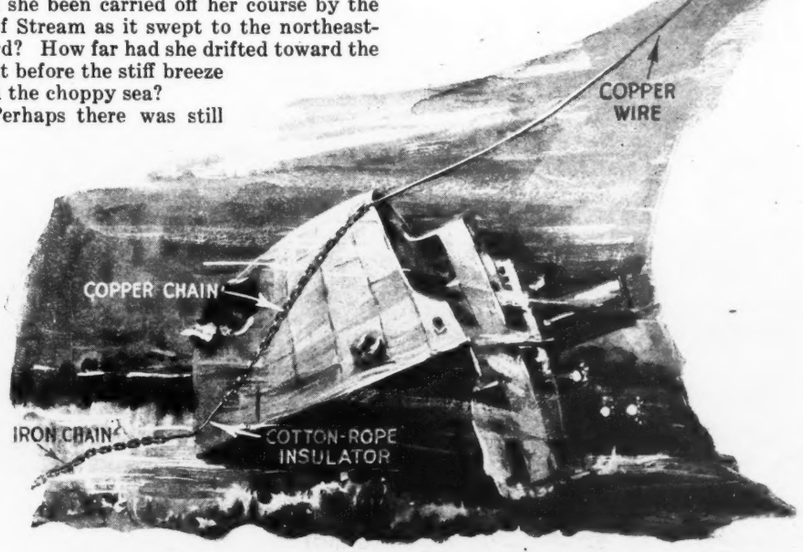
Perhaps there was still time to save the bullion. The purser had locked the safe before leaving the vessel, and Captain Robertson and Chief-Officer Nordstrom were alone on the sinking ship. They tried to break into the safe with sledge-hammers and crowbars, but the strong box resisted their most desperate efforts. Then, sextant in hand, they waited on the bridge in the darkness, while they felt the ship sinking beneath their feet — waited for dawn, for a view of the horizon, in order to take a last observation. Four hours later, just before the *Merida* disappeared, they obtained a three-star sight. This gives the most accurate position possible for navigators.

Frank Crilley, world's champion diver, who will descend to investigate the wrecked "Merida" when it is located

But even under the most perfect conditions the navigator only knows that the ship is within two miles of the point his figures say it is. The five positions turned in by various men on the spot the next morning as the place of the sinking cover an area of ten square miles! Thanks to Nordstrom's nerve, the place is fixed within about six square miles. Still, this inaccuracy means that diver Crilley may have to search foot by foot an area of ocean bottom considerably greater than the entire loop district in the city of Chicago.

When the *Ripple* left port her deck was covered with mysterious gear, and among the instruments reported were two similar to that developed by the Navy to locate submarines. With these inventions the hulk of the *Merida* might be found without sending down a diver, even after the usual method of sweeping the bottom failed. One device consists of a length of iron chain, insulated by a ten-foot section of cotton rope from a copper chain attached to a copper wire leading to a delicate relay on the trawler's deck. When the copper and the iron chain touch any conducting surface, like the iron hull of the *Merida*, they form the positive and negative plates of an electric battery of which the salt water of the ocean acts as an electrolyte. A feeble current runs up the wire and operates a delicate relay. A bell rings. Instantly the trawler stops. Over goes the anchor. The *Merida* is found. Crilley dons his special suit of diving armor that he has been perfecting for ten years, and disappears beneath the water, to rise a few minutes later with his fists full of gold!

When the trailing device touches the sunken vessel, a relay is energized that in turn rings a bell



Contact of copper chain and iron hull generates a feeble current that actuates a signal on board the searching trawler

What if the Ship Is Buried?

But what if the hull has become covered with sand by the Gulf Stream? Then the supertonic device comes into play. In this invention, a vibrator attached to a ship's hull under water emits a musical note of extremely high pitch. With a special

listening device, the treasure-seekers note the echo from the bottom. The apparatus is so sensitive that it reveals the slightest difference in the depth of the water. Now, fifty-five miles east by half north of the Virginia capes the ocean floor is normally smooth and level. Suppose the listeners find that in one particular spot there is a small sandhill on the bottom? There lies the *Merida*, buried under the sand!

A preliminary search with the wire drag drawn between two ships gave promise of success. Once it caught on some obstruction, but when Crilley went down in 178 feet (deeper than the *Lusitania* lies, by the way), he found the line caught in an old anchor. A week later, two hundred feet of the drag caught and was broken away. The spot was buoyed, but a nine-day gale drove the *Ripple* and her consort back to Norfolk to refit.

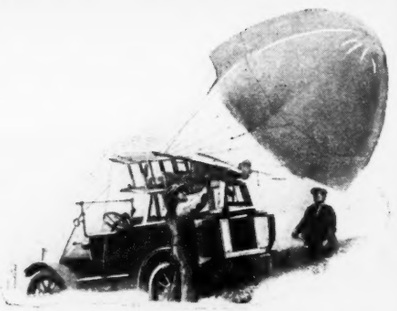
On the *Ripple's* next trip to the spot the gold may be found and raised—perhaps even before this magazine appears on the bookstands. If it meets with success, the expedition will raise new hopes of recovering hundreds of millions of dollars in treasure from ships sunk by U-boats during the war.

Even in American waters there are millions sunk in spots fairly well known. A wreck worth $5,000,000 lies under Hell Gate in New York; but the richest prize in the world is a Spanish galleon off Cornwall that is valued at $87,000,000, and that lies in water no deeper than that covering the treasure ship *Merida*.

The "Ripple" and her consort hunting the sunken "Merida" with its hidden treasure

Solve the Puzzles and Win a Prize

THE famous Sam Loyd has been engaged by Popular Science Monthly to frame a set of puzzles each month for which prizes of $25 will be given for the best answers. Turn to page 74 and read the rules.



If the airplane pilot loses control, the parachute automatically opens

Parachute Saves Both the Airplane and Pilot

BELIEVING airplanes will never be safe until automatic safety devices make a crash impossible, Charles N. Newman has invented a device that consists of a large parachute attached to the top wing and fuselage of the plane, which will open itself mechanically if the pilot loses control. The parachute may also be opened at will to enable landings to be made in a space smaller than is possible at present.

According to Mr. Newman, when the aviator wishes to land, he will zoom, trip his parachute, which will open instantly, and allow the parachute to float him slowly to the earth, alighting at any desired spot. The invention is shown being tested with a model plane.

Cattle Tested in Airtight Cell to Find Best Fattening Feeds

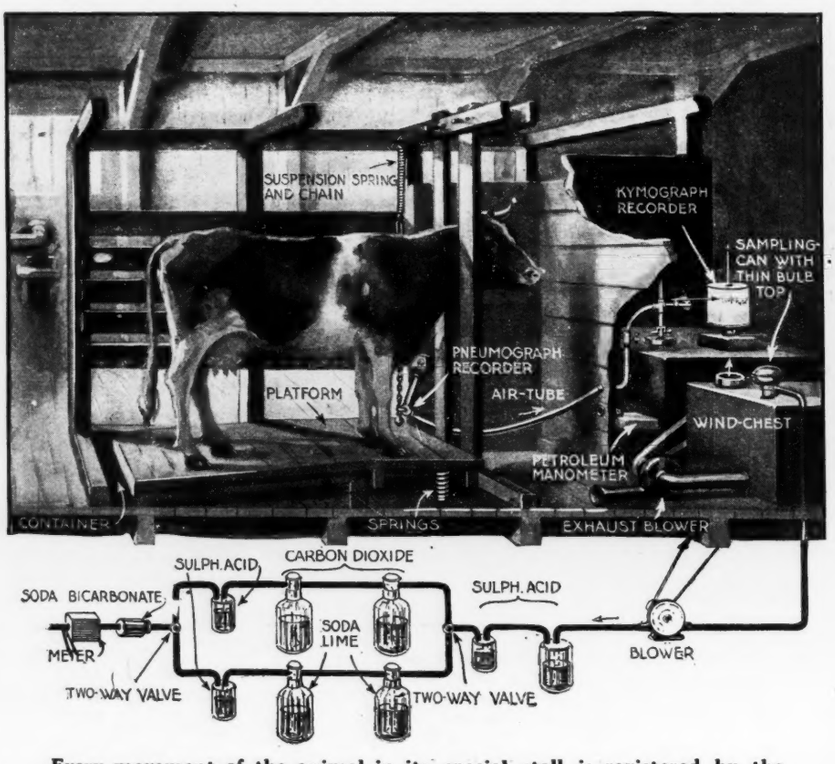
SCIENTIFIC stock feeding, in which the cattle make the utmost gain in flesh and fat for the least amount of food, is of the greatest benefit to the general public, for wasteful feeding directly increases the cost of meat. But while most ranchmen attempt scientific feeding, they are usually guided by measuring the increase in weight and girth made by the cattle. It is some time after the stock begins a new system of feeding that they begin to put on flesh, and when this method is used poor feeding may continue for a considerable time before the ranchman is aware of it. On the other hand, the influence of certain types of feeding, housing conditions, and the like may be determined almost immediately by a knowledge of the animals' basal metabolism, as measured by the carbon dioxide it gives off.

How Much Carbon Dioxide?

A cheap and comparatively simple apparatus for determining this factor has been developed by the New Hampshire College Agricultural Station. The animal is placed in an airtight stall, into which a regulated supply of fresh outdoor air is forced by an electric blower. A second blower withdraws the air from the chamber and discharges it into an aliquoting wind chest that forces exactly 10 per cent of the air through the analyzing system. It is passed through sulphuric acid to absorb water vapor, and then through the soda-lime jars to remove the carbon dioxide. Since the soda-lime contains water, and gives this up to the air, it is necessary to repass the current through sulphuric acid to remove the last traces of moisture before the air goes to the meter.

By weighing the soda-lime jars, the percentage of carbon dioxide given off by the animal can be determined in from three to four hours, and by this data the fattening qualities of the feed can be discovered—a process that would take weeks by the former method. The hinged platform is introduced to record the movements of the animal being tested, since the degree of muscular activity must be considered in interpreting the results of the tests taken.

The platform is supported on two compression springs, so that the slightest change in the center of gravity produces a movement that is recorded on the drum of a kymograph. A restless animal produces more carbon dioxide than one at rest.



Every movement of the animal in its special stall is registered by the kymograph and samples of exhaled air are analyzed by the chemical layout shown in the insert

Queer Creatures Caught when Scientists Fish

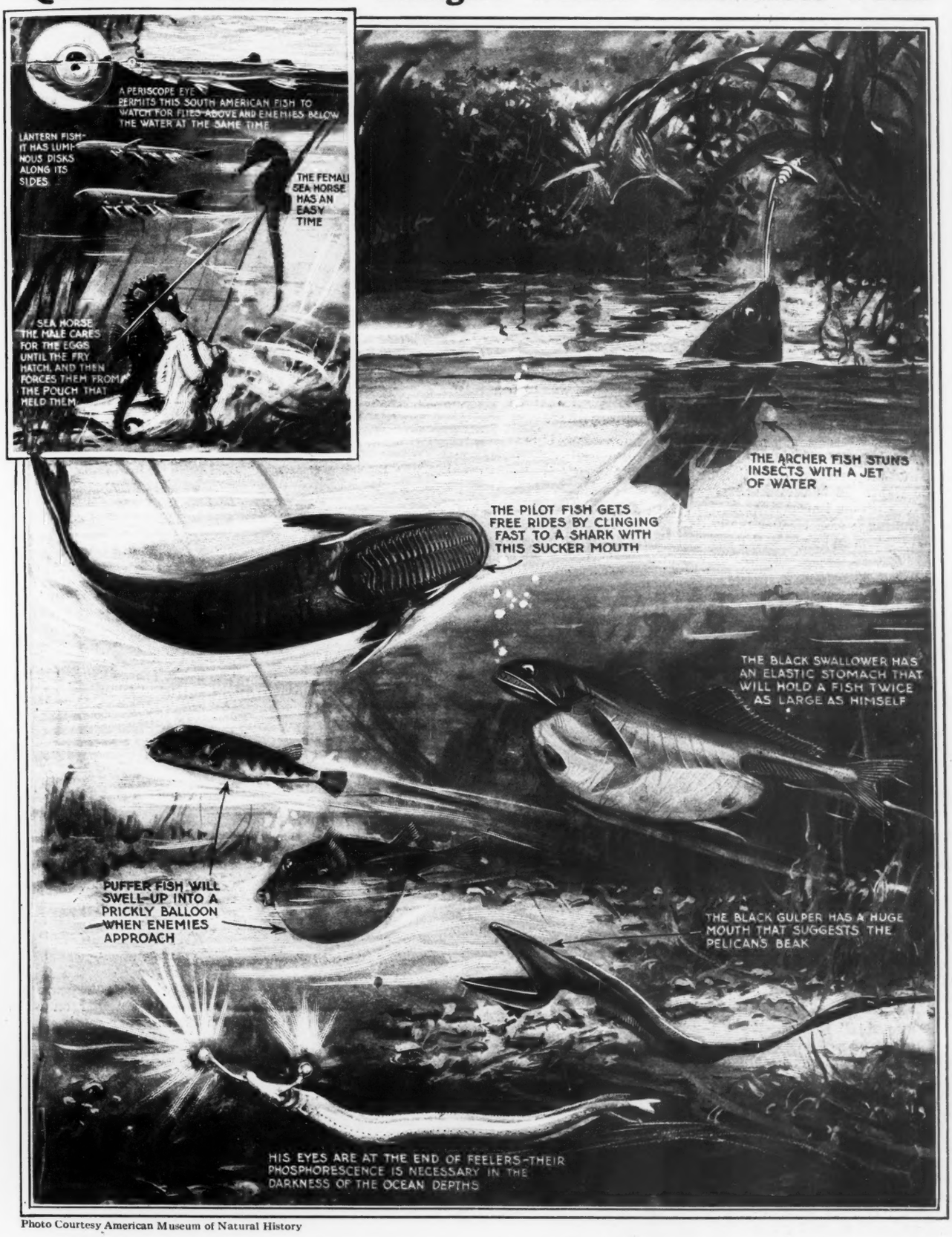
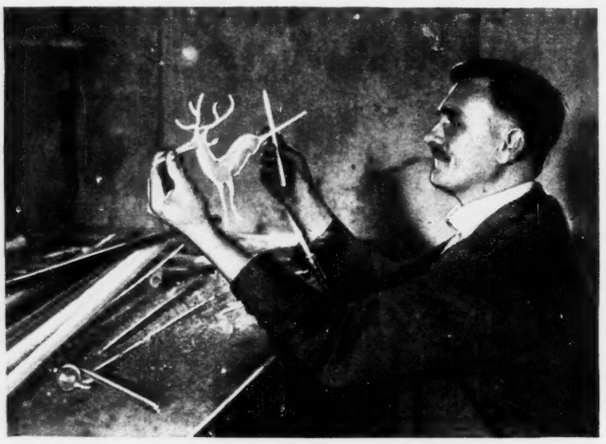

A PERISCOPE EYE PERMITS THIS SOUTH AMERICAN FISH TO WATCH FOR FLIES ABOVE AND ENEMIES BELOW THE WATER AT THE SAME TIME
LANTERN FISH—IT HAS LUMINOUS DISKS ALONG ITS SIDES
THE FEMALE SEA HORSE HAS AN EASY TIME
SEA HORSE THE MALE CARES FOR THE EGGS UNTIL THE FRY HATCH, AND THEN FORCES THEM FROM THE POUCH THAT HELD THEM
THE ARCHER FISH STUNS INSECTS WITH A JET OF WATER
THE PILOT FISH GETS FREE RIDES BY CLINGING FAST TO A SHARK WITH THIS SUCKER MOUTH
THE BLACK SWALLOWER HAS AN ELASTIC STOMACH THAT WILL HOLD A FISH TWICE AS LARGE AS HIMSELF
PUFFER FISH WILL SWELL-UP INTO A PRICKLY BALLOON WHEN ENEMIES APPROACH
THE BLACK GULPER HAS A HUGE MOUTH THAT SUGGESTS THE PELICANS BEAK
HIS EYES ARE AT THE END OF FEELERS—THEIR PHOSPHORESCENCE IS NECESSARY IN THE DARKNESS OF THE OCEAN DEPTHS

Photo Courtesy American Museum of Natural History

NOWHERE in nature, unless it be in the insect world, can such weird creatures and wonderful organisms be found as among the fishes. Some of the queerest of these queer fish are illustrated above.

So few fish live in the depths inhabited by the gulper and the black swallower that one meal must last them a long time—and their stomachs can hold everything they can get, although their prey is often larger than they are. These fish have no scales, and their skin is porous so that they may not be crushed by the tremendous water pressure.

The puffer and the lantern fish are examples of animals that frighten their enemies by suddenly taking on a formidable appearance, although they are quite harmless. The bifocal eyes of *Anableps Ietrophthalmus*, shown at the top of the inset picture, enable him to see his enemies under water while he skims along the surface and watches for prey above water. The pilot fish does not guide a shark to prey. His only idea is to get a free ride, and to be on the spot when the shark makes a kill. Commonest, and perhaps queerest of all, is the sea horse. It is the male who takes care of the children and who keeps his young in a pouch as do the female kangaroo and opposum



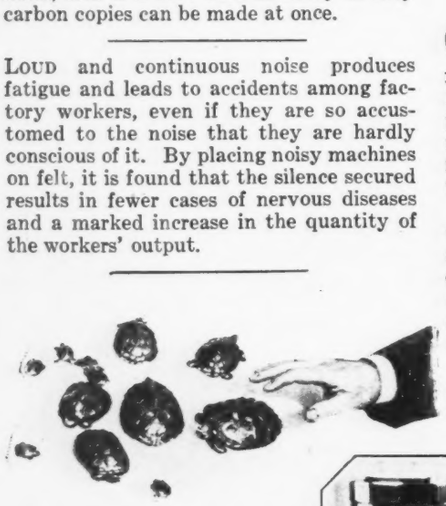
© Kadel & Herbert

Electric Typewriter Rests the Fingers

NO more pounding the keys! No more tired wrists for the stenographer at five o'clock. A new electric typewriter uses magnetic solenoids to operate the keys, and the stenographer merely depresses the bars enough to make an electrical connection. There is practically no muscular work at all in typing.

The machine is connected with the lighting circuit by a wall plug, and prepared for operation by throwing the switch shown at the right. It is very light in weight. The force of the impression can be regulated, and it is said that as many as fifty carbon copies can be made at once.

LOUD and continuous noise produces fatigue and leads to accidents among factory workers, even if they are so accustomed to the noise that they are hardly conscious of it. By placing noisy machines on felt, it is found that the silence secured results in fewer cases of nervous diseases and a marked increase in the quantity of the workers' output.



Raising Terrapins for the Market

IT is not necessary to be a psychoanalyst to know that the reaction from the word "terrapin" is "soup." And because terrapin soup and the flesh of terrapin tickle man's palate, and because the creature is not too plentiful, it pays to breed it.

The United States Bureau of Fisheries has become a successful breeder of terrapin; not for what could be got out of it, but in order to help such citizens who desired to breed them for the market.

The illustration shows all sorts and conditons of terrapins, from those a few days old to a hoary old grandfather. The diamond-bodied terrapin, so called from the pattern of its shell, has the best flavor and commands the highest price.

Relief Maps Made from Mold

ORDINARY maps can be converted into relief maps of wonderful accuracy by a new process invented by a Munich sculptor. The original mold is produced by a secret process that first makes the paper of a common plane map flexible, so that it may be stretched over the elevations and hollows of the model.

Paper so treated is brought into contact with a special plastic matrix material that adheres and amalgamates with the paper coating. Both the covering and molding mass remain plastic for some time, so that even the most minute details of relief may be worked out with hand tools.

This original mold is used to produce a stamping-mold with which any number of plastic maps can be manufactured.

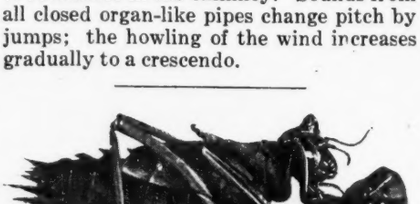
This stamping machine makes accurate relief maps from ordinary maps by an economical process

Stag Blown from Single Glass Tube

SCULPTURE in molten glass is something new, but an expert glassblower does not find it extraordinarily difficult. The glass deer illustrated above was produced by a German workman in less than half an hour, merely as a lunch-hour recreation.

One piece of glass was used in blowing the entire stag, antlers and all. There was no patching or fusing bits of glass on to a molten surface, as is done in making the marvelous glass reproductions of sea-anemones and other marine growths for museums. As a result, the stag is very fragile, since even the antlers and the slender legs are hollow.

HOWLING of the wind as it sweeps over chimneys and roofs is caused by eddy motions in the atmosphere immediately behind the obstructing object, and is not due to resonance in the chimney. Sounds from all closed organ-like pipes change pitch by jumps; the howling of the wind increases gradually to a crescendo.



Catches Prey with a Natural Trap

A PECULIAR traplike appendage, called the mask, enables the young dragon fly to capture the mosquito wriggler on which it feeds. The mask consists of a jointed, articulated arm that is attached to the under side of the head. At the extremity of this arm is the mask proper, which consists of two folding parts like hands, each of which is provided with a row of small sharp teeth on its outer edge.

When a tiny insect passes within reach of the young dragon fly it suddenly thrusts out the mask, grasps the insect within it, and backs it into the mouth. When this organ is not in use, it folds back over the head, covering it like a mask.

The young dragon fly lives in ponds and streams and is very slow-moving; this trap is its salvation.

Soil-Drill Made of an Old Auger

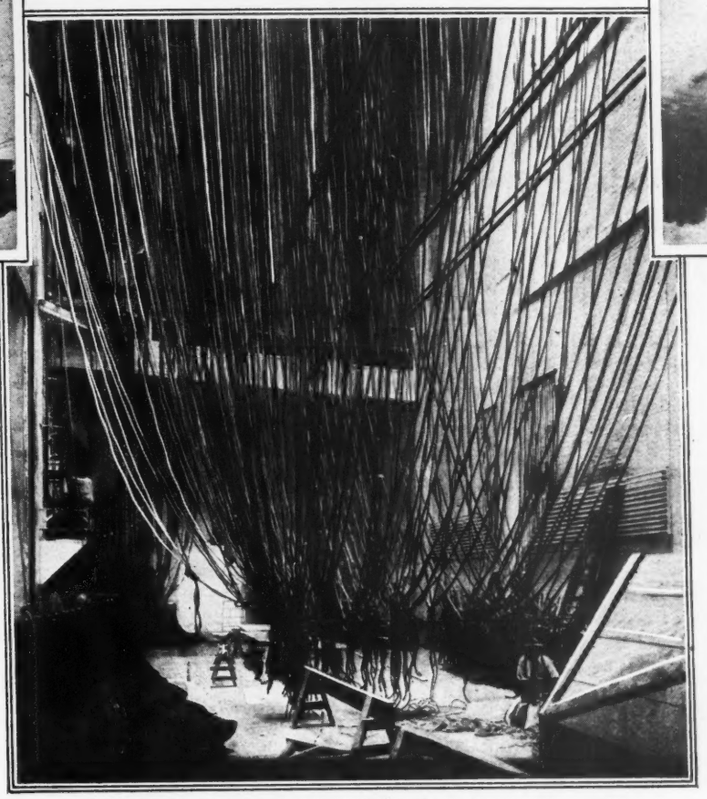
A HAND-POWER auger that may be used to prospect for water or to put down a bore-hole for pipe and sandpoint may be made by cutting the screw from a two-inch wood-auger and splitting the end of the auger one half inch, then turning down these lips just enough to take hold of earth. Weld on a four-foot shank and it is then ready for a six-foot strip of tire, which may be fastened on with a bolt, and a few turns of smooth wire to serve as a sleeve.

Obviously, this auger will not work in rock, but it is effective in soil, sand, or soft sandstone.

Stage Hands Must Know Their Ropes

IF it were not for the mechanics of the thing—all the hard work behind the scenes—our elaborate theatrical scenic productions would be impossible.

A glimpse behind the scenes in a typical theater, shows about one hundred and fifty of the innumerable ropes necessary for shifting theatrical drops quickly, noiselessly, and without confusion. Thousands of feet of rope are necessary for this work, yet the forest of cordage is so well concealed that the audience never sees one rope during the performance. One-inch manila rope is used in this work as years of service have proved this size and kind to be best adapted for the purpose.



The cobweb of scenery ropes behind a theater stage. It requires an expert to pull the right one at the right time

Courtesy U. S. Bureau of Fisheries

Feeding Hungry Fish through Ice

THIS is a winter scene on one of Uncle Sam's fish-farms. The pond contains thousands of little fish that will be sent about the country in the spring to replenish the supply in many lakes and rivers.

The baby fish must be well taken care of. They are fed every day through a hole in the ice, beneath which they gather like hungry chickens when they are being fed. The food must be just right, so that the fish will grow fast. In the spring they are collected and shipped in big tin cans to the Government's many public park and reservation rivers.

Bob-Sled Run by Old Motorcycle

FORTY miles an hour over snowbound roads is the speed claimed for an ingenious motor-bob contrivance built by two lads in Barre, Vermont.

A motorcycle minus the front wheel supplies the motive power. The motorcycle is encased in a wooden frame with the front fork resting on and securely attached to the front sled and with the rear held firmly in front of a double seat. Controls are fitted that render the operation of the strange vehicle as easy as driving an automobile.

In spite of a heavy fall of snow the lads piloted this outfit to the top of the steepest hill in Barre, and made good use of it in traveling back and forth between the city and their home.

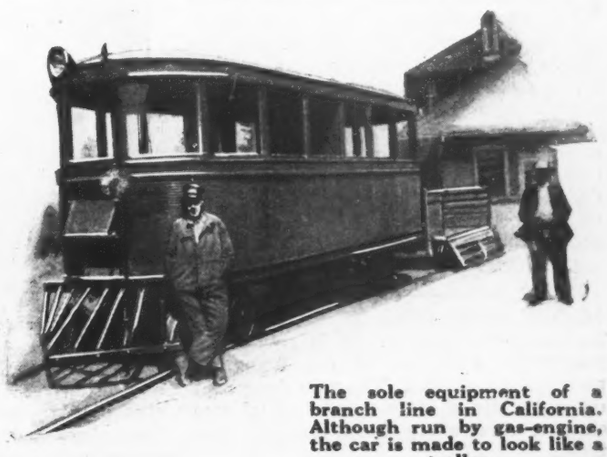
With its front wheel gone, the motorcycle is still useful as the motive force for the bob-sled

Loco-Trolley Has Gear-Shift like Auto

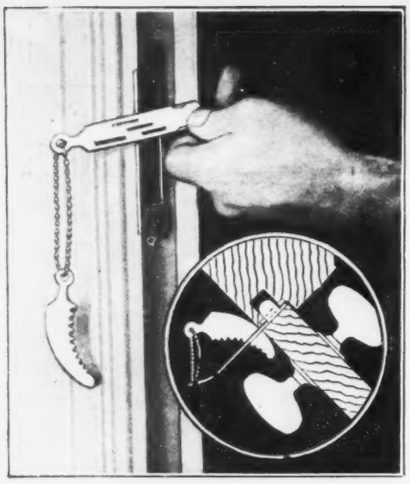
AN automobile engine and chassis mounted on railway wheels is a way train that runs between Quincy and Quincy Junction, California. Engine-tender wheels are used in front, freight-car wheels in the rear.

The whole outfit runs on rails and weighs eleven thousand pounds. It has a rear axle drive and gear-shifts and is operated the same as an ordinary automobile. It is equipped with four speeds forward and a reverse, and has such pulling power that it will make a steep grade nearly all the way on fourth speed.

The car and tender comprise the sole rolling stock of the line.



The sole equipment of a branch line in California. Although run by gas-engine, the car is made to look like a trolley



Attachment Makes Any Lock Burglar Proof

BANK presidents will testify that there is no such thing as a burglar-proof lock. Given time and enough nitroglycerine, and any door can be opened; but this attachment will prevent the lock on a door from being picked or opened with a skeleton key. It is carried in the pocket and attached without screws.

The teeth on the slotted section are inserted in the lock plate on the door and the toothed catch is forced into the slots extending across the door-frame. The result is a bolt that holds the door shut against any force weaker than a stick of dynamite or a battering-ram.

New Combination Scale Truck

By raising a single lever, the platform of this truck can quickly be changed into a scale

© Underwood & Underwood

CHANGING this hand truck into a scale is an exceedingly simple and rapid operation accomplished by raising the handle of the lifting lever a few inches. The leverage is so compounded that a child can easily raise a ton.

The scale and truck are both of standard construction, but the combination of the two in one machine is expected to save time and facilitate production by making it easy to keep accurate records of the weight of goods shipped and received without delay in unloading.

MINERS' consumption is neither contagious nor infectious. It is caused by mechanical irritation of the lungs by particles of rock dust. The most dangerous dusts contain a large proportion of free silica or other sharp, hard, insoluble material.

A Motorcycle of Featherweight Construction

SMALL wheels and a stringent economy in metal wherever possible are responsible for the extreme lightness of this new motorcycle, which is probably the featherweight champion of the world. It weighs

Transportation at one-sixth cent a mile is achieved by this pygmy motorcycle

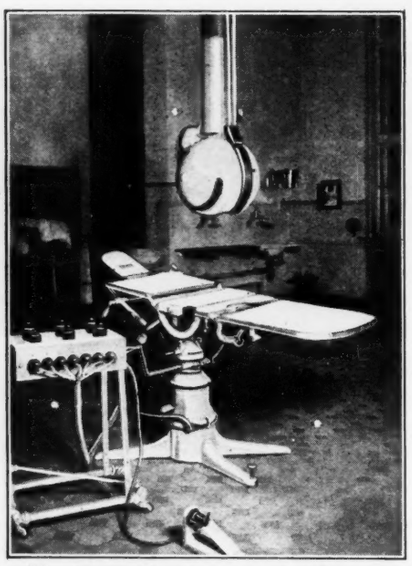
but 99 pounds. Its touring radius is 120 miles, and it makes 30 miles an hour.

Locomotion at the expense of spoonfuls of fuel has been achieved by this machine, which requires only one quart of gasoline for each hour's operation.

Speaking of Operations

TO take moving pictures of surgical operations without interference with the doctors, an apparatus has been invented by Dr. Alexander V. Rothe. The apparatus in periscope form is let down over the operation table and its action is governed by the surgeon. The film roll is fed into the periscope from another room; and the light is produced from a distance.

Ordinary moving-picture machines took only a side view and disturbed the surgeon, but with this machine an exact picture is taken from above; in fact, it is the picture that the surgeon himself sees as he looks



The inverted periscope and globe is a motion-picture camera used to make film records of operations

down at his work. The films can be reproduced slowly, and are used to teach medical students the proper surgical technique. They also permit surgeons to compare their methods.

Sanitary Shaving-Brush—Used Once and Thrown Away

A SHAVING-BRUSH to be used once and then thrown away has been devised by a believer in ultra hygiene, who declares that it is almost impossible to sterilize the ordinary shaving-brush and that even if the brushes are thrown away, the article will not be perfectly sanitary if the same handle is used over and over again.

In this sanitary shaving-brush suggested for barber-shop use, the producing end is used as a handle. The bristles are made of a vegetable fiber and the brush is wrapped in a germ-free sanitary package.

London Has a Baby Strap-Hanger

IN London, an ingenious father carries his crippled baby from place to place in a reed basket supported by a strap over his shoulder. Indoors the cradle is placed in a hammock.

This arrangement is much less liable to jolt the baby when carried through the streets than the usual perambulator, no matter how carefully the latter is handled. The cradle is homemade, and was invented by the father to fit his child's needs.

HOUSE flies not uncommonly travel from five to six miles in a straight line in twenty-four hours. Their maximum journey is thirteen miles, as recorded by experiments of the United States Bureau of Entomology. Propelled by wind, flies have been carried from Cuba to Florida.

This wireless set in a coconut shell has a receiving radius of seventeen hundred meters

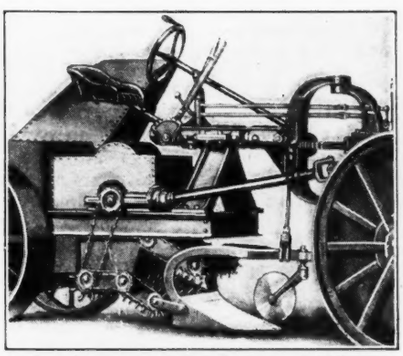
Wireless in a Nutshell

FROM Peckham, England, comes this complete wireless receiving station constructed in a coconut shell by C. Sanders, newsagent and tobacconist. The station is not a freak, but a practical instrument that has received messages up to seventeen hundred meters wave length. It will reproduce speeches and music sent out on the wireless telephone. The maximum range is about a hundred miles.

This Weeding Tractor Actually Combs the Soil

NO weeds remain in the soil after this new tractor has passed. It has been estimated that weeds reduce the value of crops throughout the United States by $300,000,000 annually.

The tractor is of standard design, except that an extra power shaft extends from the rear of the transmission case and connects with the weed-extracting mechanism. The plowshare cuts a furrow of regular size and of any depth desired up to seven inches, which contains the weeds, roots and all.



Revolving teeth comb the weeds from the lifted sod and deposit them in a box on the tractor

But instead of turning this furrow-slice upside down and tossing it to the right (as is the case with the ordinary plow) the absence of a mold-board allows the ribbon of earth to pass directly to the rear, where it comes in contact with the prongs on the belt-conveyors.

These pull the soil into the weed-separating mechanism, which consists of a series of revolving cylinders set with teeth that curry and comb the weeds out of the soil. The earth is then returned to the vacant furrow, while the roots and weeds are discharged into a tight wagon box attached to the tractor drawbar, in which they can be hauled away and burned.

Auger Bores Holes and Then Drives Posts

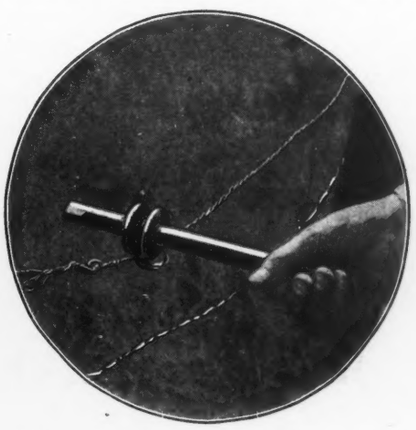
AN earth-boring auger has been invented by Jesse G. Rowe, Jr., of Davis, California. It is mounted on a portable truck and is provided with novel means for driving the auger downward.

When the vertical shaft is rotated by the hand wheel, one spring is wound on a drum while another spring is paid off the drum.

After drilling the hole, another attachment, run by the same motor, drives in the post

In this way a horizontal swinging movement may be imparted to the frame. The object of this horizontal swinging of the frame is that the auger can be properly positioned to bore the hole into the ground, and subsequently a hammer operated by the apparatus may be used for driving a post into the hole made by the auger. The post-driving action is a part of the mechanism and is operated by the engine.

Tool Splices Broken Fence Wire

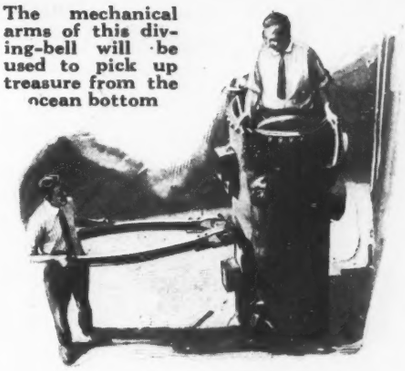


WITH this tool broken fence wires are pulled tight while they are being spliced. The first step in repairing the fence is to make a loop on each end of the broken wires, fasten a short piece of wire to be used in the repair to one of the loops, and slip its free end through the other loop. The end is then wrapped around the spool of this iron tool, and wound up until the wire is taut.

A crank fitting over the squared end can be used if necessary. After the wires are tight, the splice is fastened by making a fourth loop with the wire wrapped around the spool of this very handy tool.

SHORT ends of steel bars otherwise wasted are salvaged by welding them electrically into long bars.

The mechanical arms of this diving-bell will be used to pick up treasure from the ocean bottom



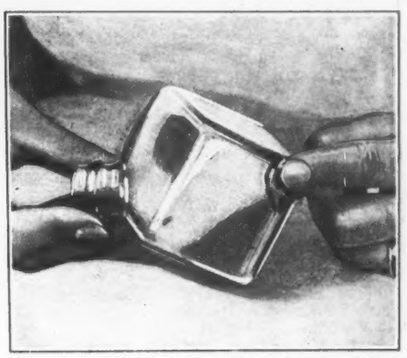
Diving-Bell Is Fitted with Mechanical Hand

HUNDREDS of ships sunk during the war at depths too great to permit salvage by ordinary methods have stimulated the invention of improved diving-bells. The invention of Alex O. Tesch is equipped with arms to pick objects from the bottom of the sea, and an eight-horse-power motor and propeller to allow the diver to direct his course under water. It is not expected that these diving-bells will be used to raise sunken vessels. Protected against the water pressure by a half-inch wall of steel, the diver circles the sunken hull until he finds an opening by the rays of a searchlight carried at the top of the bell. Once inside, he endeavors to pick up valuable cargo or chests of specie with the mechanical arms, which are operated from the interior.

How a Paper-Weight Helps to Sell Concrete-Mixer

IF you had a concrete-mixing machine that worked in an unusual manner, in which the contents were folded upon themselves twelve times with every rotation of the cube-shaped mixing-chamber, how would you start to sell it? The mixing feature must be demonstrated, but you could hardly persuade a prospect to put his head inside a moving concrete-mixer.

The problem has been solved by the use of a hollow glass paper-weight in the form



This paper-weight filled with sand illustrates the action of the concrete-mixer that it advertises

of a cube, the same shape as the mixer of the machine. This is filled first with a layer of red sand, then with a layer of white sand, and finally a bean is dropped on the top. As this paper-weight is rotated between the fingers, the folding action is shown by the patterns formed in the red and white sand, and the proof of the folding action is the fact that the bean comes right up through the mixture three times with every turn of the cube.

Trouble Lamp Leaves Both Hands Free

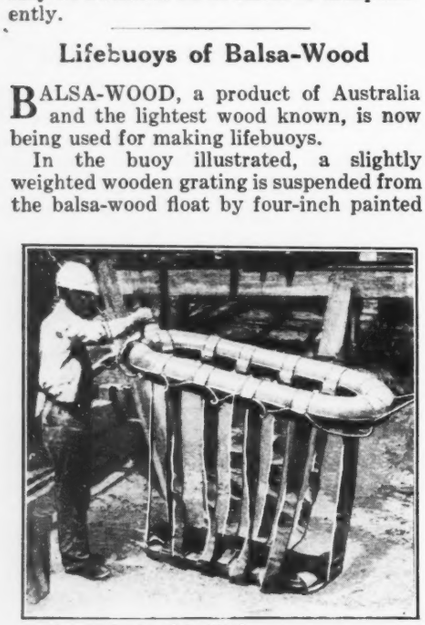
SO that it may be worn over jacket or shirt, this electrician's trouble lamp has a buttonhole hook. Like antennae, two contact-point wires lead out from the lamp-box, which the electrician uses as sure "diviners" of current leakage. If there is an escape of electricity, his lamp lights.

The lamp is in a flat tin box that may be carried in the pocket when not in use. The box has little perforations in the front for the lamp rays. In other words, the lamp is not exposed on any side. The bulb hangs from a spring socket, and there is no danger of a sharp jar causing breakage. For testing different resistances, other models of the device have two or three lamps, which may be switched on in series or independently.

Lifebuoys of Balsa-Wood

BALSA-WOOD, a product of Australia and the lightest wood known, is now being used for making lifebuoys.

In the buoy illustrated, a slightly weighted wooden grating is suspended from the balsa-wood float by four-inch painted canvas strips. The shipwrecked persons stand within the float upon the grating. Thus they find themselves much more comfortable in the water than with feet dangling and the weight of their bodies unnaturally supported from elbows and shoulders.



Not only is this lifebuoy more comfortable than the circular kind, but it will sustain four persons

This lifebuoy occupies but little more space than two circular lifebuoys, and is easily carried by one man. It will sustain four persons.

Electric Manicuring Machine

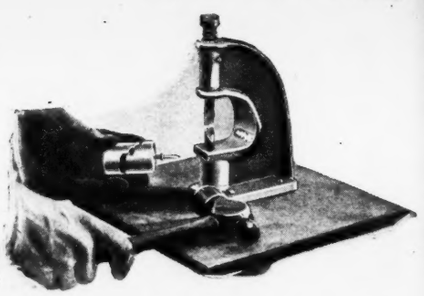
WITH rotary files, buffers, and polishers which can be slipped into a whirling shaft, an electric manicuring-set will appeal to the efficient as well as to the fastidious. Under the dainty case of filigree is a little electric motor, and by slipping the various attachments into the chuck the finger-nails are manicured by power in exactly the same way as it is done by hand, but with a great gain in speed and a vast improvement in the result.

Finger-tips can be manicured neatly and quickly by this motor-driven device

How Concrete Is Waterproofed

THERE are two reliable methods of waterproofing concrete foundations. One method consists of mixing a certain compound into paste form with the concrete when poured. This material is carried throughout the walls with the concrete mixture, but when the water evaporates, it leaves behind it the proofing substance that dries and fills the pores in the concrete, making it non-porous and therefore preventing capillary action.

The second method consists in placing a thin layer of cement plaster in which the waterproofing material has been mixed over the outside of the concrete foundation. The former method is used on new buildings and the latter on old ones.



This Punch Clinches Nails for Electricians

NAILS can be clinched by means of a hammer with this simple punch. It is designed for the use of electricians who have many knobs to assemble. The punch flattens a small section of the nail, holding the parts of the knob in place. By using nails instead of screws, wiring can be strung more quickly, since the knobs may be rapidly nailed into space.

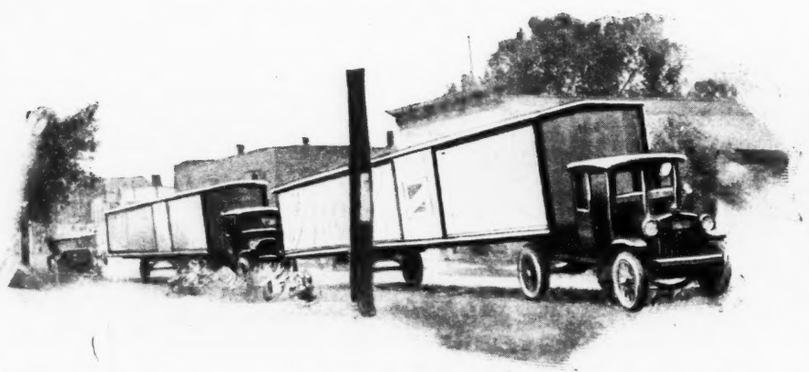
Direct Reading Exposure Meter for Cameras

CORRECT photographic exposures are read directly without calculations or the use of sensitized paper by the exposure meter illustrated. A scientific principle not used heretofore in these devices is employed, by which a colored square of glass in the stem is held to the light, and the scale turned until the same color appears in the space below. The correct exposure for all stops then appears directly on the scale.

The instrument is about the size of a watch, and may be carried in the vest pocket. As it measures the strength of light at the point where the camera is to be used, it eliminates all guesswork about the shadows cast by buildings and trees, where even the experienced photographer is liable to go wrong and spoil a film.

A pocket-sized light meter for the amateur photographer

Hauling Automobile Bodies in Special Trucks



FREIGHT-CARS of the road, sixty feet in length over all, are used to haul automobile bodies from Detroit to Flint, Michigan. The wagons were made this unwieldy length in order that the motor-truck might pull its maximum load, preventing wastage.

Demonstrating a Diving-Suit in Show-Window

HOW divers work under water was demonstrated at a London exhibition by means of a large water-tank with a plate-glass insert in its front.

The illustration shows the arrangement of the double ropes, one for support and the other for signaling, and the attachment of the air tube. A telephone inside the diver's helmet enables the diver to talk with his tender on the surface of the water, but the old-fashioned signal-cord is kept in case of failure of the phone. For the same reason diver's air-pumps are almost invariably worked by hand.

The "Angora" Tomato Is Grown in New Jersey

IN an inspection of a fifteen-acre field of tomatoes for seed purposes last year the New Jersey Agricultural Experiment Station experts noticed a single plant with silvery foliage. Seed was saved from several of the fruits and most of the plants grown this year have the same silvery appearance.

This particular characteristic is due to excessive hairiness of the stems and leaves, which gives a velvety finish to the plant. In many plants it indicates ability to resist drought.

Improved Hand Truck Equal to a Helper

WITH the truck invented by a Philadelphian, Mr. J. C. Moore, one man can handle boxes and bales for which two men were formerly needed.

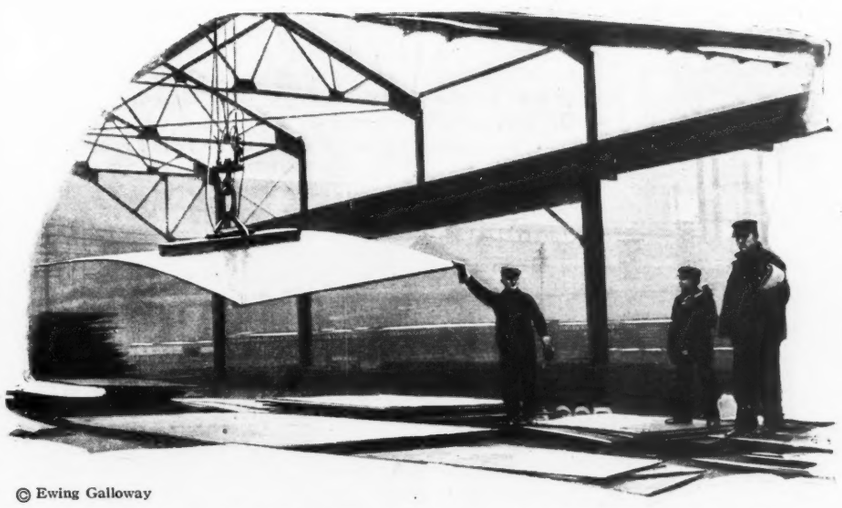
A man using this truck can move anything he is strong enough to tilt. It is not necessary to raise the edge of the object to be moved, as the spurs will engage any surface against which they are set.

The chain enables one man to pick up heavy and bulky cases

The flexibility of the chain with the hook on the end makes it possible to handle packages that are higher than the point where the chain comes out of the barrel or tube, something that cannot be done with trucks that have a rigid metal arm fulcrumed on the top of the frame. The links of the chain are so made that they lock automatically at any point.

The operator has both hands to use on the truck handles and is not obliged to twist himself around in an effort to tilt the box or package with a baling-hook while he tries to steady and control the truck with one hand. In the illustration a man weighing 140 pounds and not accustomed to heavy work is handling a packing-case weighing more than 650 pounds.

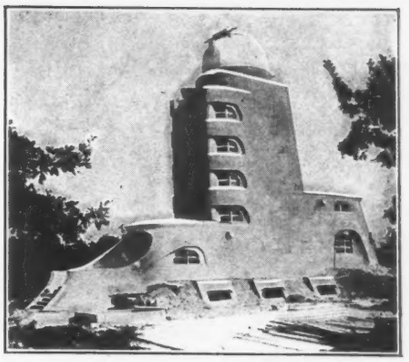
Lifting Magnet Especially Adapted to Flat Sheets



© Ewing Galloway

FLAT steel sheets and ship's plating are being handled by a specially constructed lifting magnet in the yards of a Chicago steel company. The principle is a familiar one in the unloading of pig iron and small steel articles, and by making the magnet long and flat the same efficient stowage is obtained for large plates.

Large plates have always been awkward to handle, but with the new device, only one man is needed on the ground, and he merely guides the shapes into place.



Einstein's New Laboratory Is Odd Structure

IN this queerly shaped observatory, Professor Albert Einstein will attempt to prove his theory of relativity. His equipment will comprise a complete physical laboratory, and an astronomical observatory with a small telescope, since much of Einstein's data has to do with the path taken by light from the stars as affected by gravitation.

The building will also be used as an experimental station by the Astrophysical Institution of Potsdam.

Universal Square Locks at Any Angle

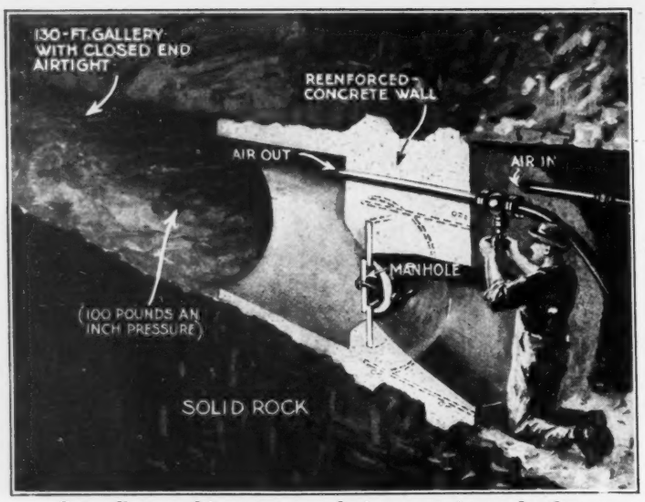
THE blade rotates freely in a slotted aluminum handle of this universal square. The concealed end of the blade is provided with a series of five pairs of holes, any two of which can be engaged by a pair of taper studs mounted on a flat spring extending the greater length of the handle and under tension against the blade. With the blade swung to the right, these studs lock it

The movable blade is set at any angle and can be locked in the five positions most used

in any one of the five positions most commonly used, such as the square, double mitre, or double octagon. These adjustments are obtained instantly by pushing the button with the thumb of the left hand while moving the blade with the right.

When the blade is moved into line with the handle, it is held semi-positively by the engagement of one stud for the purpose of being carried readily in the pocket or toolbox.

The positive locking engagement ceases when the blade is swung to the left, and it may be moved over a range of 155 degrees into any desired bevel position. After the required angle has been found, the blade is held frictionally by tightening the knurled nut on the opposite side of the square from the button. A reverse motion quickly disengages the blade.



So well was this compressed-air reservoir made that there is a leakage of less than two pounds pressure in six hours

Compressed Air in Mine-Shaft

COMPRESSED air has been successfully stored in a rock reservoir constructed in an abandoned blind heading in a Belgian coal-mine. Air is stored at one hundred pounds to the square inch, and the combination of solid rock and a cement lining has proved virtually impervious.

The heading is close to the shaft, about seven hundred feet below the surface. In building the reservoir, the opening end of the heading was closed by a reenforced concrete wall, in which an opening was left to give access to the tank. Two six-inch pipes were carried through the wall, one for the admission and the other for the discharge of the compressed air, and a one-inch pipe with a valve is used to let the air into the mine.

The rock walls were coated with a slow-setting liquid cement applied under a pressure of two hundred pounds to the square inch in order to plug all the fissures in the rock, and steel rails were embedded in this coating to strengthen the walls. The reservoir is 131 feet 2 inches long, with a capacity of 4767 cubic feet.

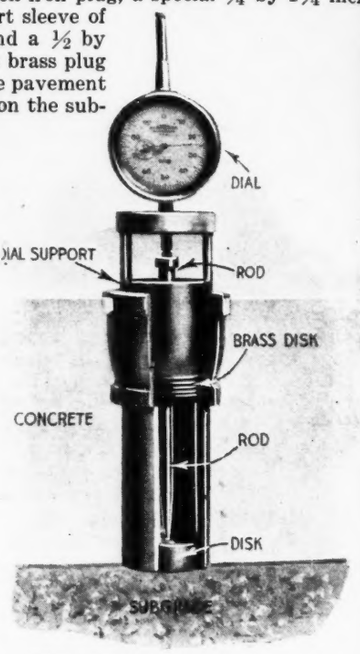
Cylinder Tests Subgrades

INFORMATION as to the uniformity of the subgrade under different sections of a highway, and an excellent opportunity to gather valuable data on subgrade conditions, including expansion, contraction, bearing power and moisture content, is afforded by the testing apparatus designed by the Illinois Highway Department.

The subgrade-testing cylinder consists of a 1½ by 1¼ inch black iron reducer, a short length of 1¼-inch black iron pipe, a 1½-inch countersunk black iron plug, a special ¼ by 1¼ inch brass bearing-plug, a short sleeve of 1-inch black iron pipe and a ½ by 1¼ inch brass disk. The brass plug is flush with the top of the pavement and the disk rests freely on the subgrade. The length of the pipe and sleeve varies with the thickness of the pavement in which the cylinders are used.

The brass disk follows the downward movement of the pavement and the upward movement of the subgrade, so that any separation between the subgrade and the bottom of the pavement can be learned by measurements taken from this plug.

The difference between initial readings, taken as soon as possible after the testing cylinders are placed, and readings taken at subsequent times, shows any change in position between subgrade and pavement.



This simple device will test subgrades, giving data on expansion, contraction, bearing power, and also the moisture content

Four-Foot Power Boats Make Their Thirty Miles an Hour

VISITORS to Central Park, New York, are astonished to see tiny boats skip across the ponds with their engines snorting frantically and water boiling in their wake. These little boats are real products of high engineering and mechanical skill. They are propelled by intricate flash-steam plants with engines that develop as much as one horsepower under brake test, although they are small enough to rest in the palm of the hand.

Model power-boat racing is fast becoming a great hobby with mechanically inclined Americans and within the next few years it would not be surprising to see this develop into a recognized American sport. In a way, these little craft stand on a par with the large power racing-boats that attain speeds of between sixty and seventy miles an hour. At the present time, final arrangements are being made for an international race, which will bring the best model power-boat builders of Europe over here to race their craft with the American boats.

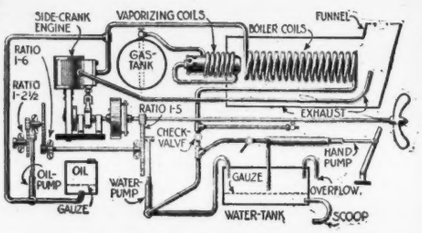
The flash-steam plants that drive these models are much more powerful and efficient than ordinary pot-boilers, since they generate greater power for a given weight and fuel consumption. Heat is supplied by a gasoline torch, the flame of which shoots forward through the boiler coils, made of steel tubing. When the water from the pumps reaches the coils, it instantly "flashes" into steam, and as it passes through the remainder of the coil it becomes highly superheated. It is really transformed into a hot, dry gas. Great care must be taken to maintain precisely the right amount of heat, the proper supply of water, and effective lubrication.

It will be noticed that the small water reservoir is placed below the water-line of the boat, so that it is full when the model is at rest and is kept full while under way by the scoop projecting through the hull.

Motor-boat models equipped with the miniature flash-boiler plants described at the right have been propelled through water at the rate of thirty miles an hour

It is very important to have a gauze strainer near the bottom of the tank, since any obstruction will cut off the flow of water and steam. The same precaution is taken with the oil reservoir. The oil is supplied by a pump geared to the main shaft, and the engine is lubricated by mixing oil with the superheated steam before it enters the cylinder. A very heavy, viscous oil must be used to withstand the heat.

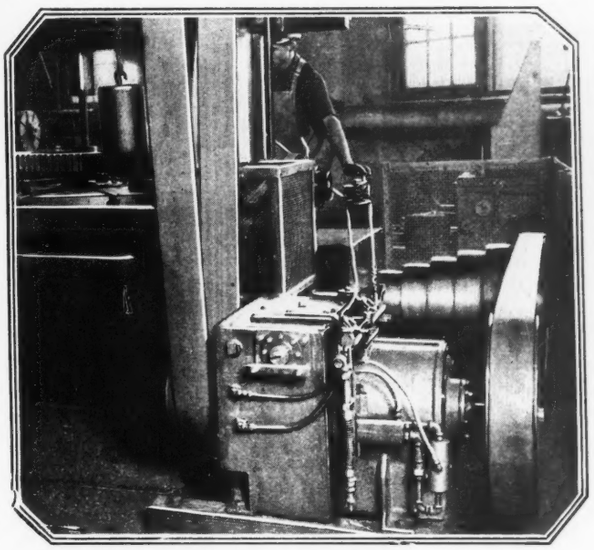
Once started, flash-steam plants will work automatically, but they are very difficult to adjust, and are easily thrown out of adjustment by minor causes. Every joint must be absolutely air- and water-tight, as the pressure must be high throughout the system. Every square inch of the boiler coils is heating surface, and the amount of water and heat supplied to the boiler must be exactly what it requires, neither more nor less. Too much heat breaks down the oil, and a failure of the lubricating system is disastrous.



Machines and Tools to Do the Job Better

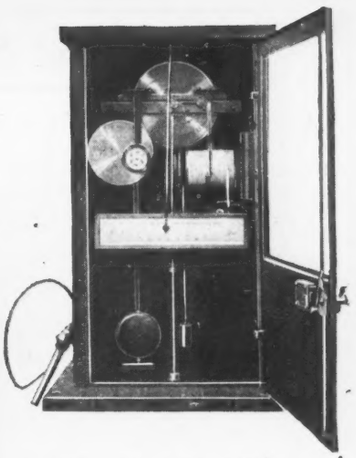
Two-Spindle Threading Machine

A double-spindle threading machine saves the time of the operator by permitting him to set up one while the other is working



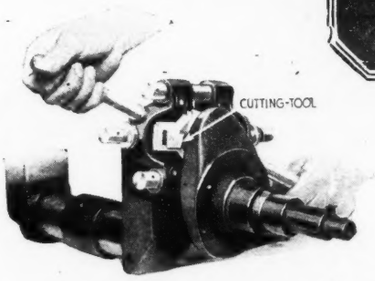
Oil-Speed Control

By means of a single lever the operator of this seven-foot boring-mill can obtain any desired speed at will, saving 35 per cent in time



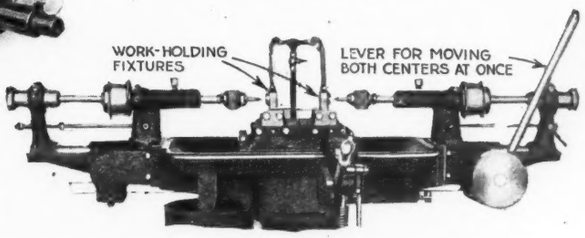
Recording Feed-Water Thermometer

A thermometer immersed in the feed water registers its temperature and transmits a record of it through a Bourdon gage to the pen, which traces it on a revolving roll



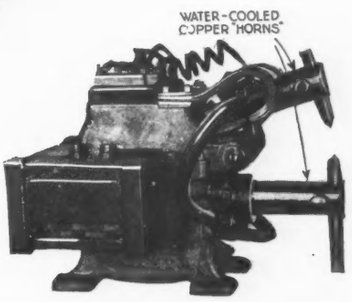
Bearing Turner

A small device for turning crankpins and bearings to an accuracy of one one-thousandth of an inch. It will accommodate diameters of from 1¼ to 2½ inches



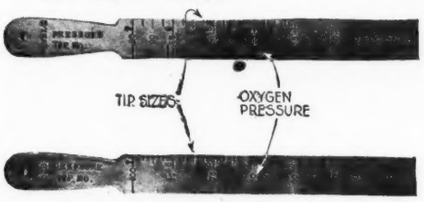
Double-Action Countersinker

Two spindles, each driven at a speed of 2000 r.p.m., are fed simultaneously by the lever at the right. A valve in the feed controls the cutting fluid



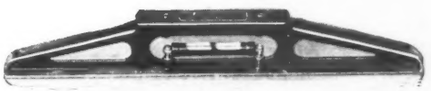
Bench-Type Spot-Welder

For small laboratory work where welds in sheet metal, platinum, and tungsten are frequently made. It occupies a space of only ten by seventeen inches



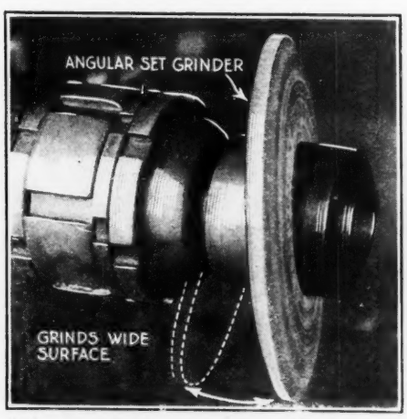
Handy Gage for Metal Cutter

A graduated rule that translates the thickness of metal to be cut by oxy-acetylene flames into terms of gas pressure and tip sizes



Machine-Alining Level

With a guaranteed sensitiveness of .0002908 inch a foot, a twenty-seven-inch level is a valuable adjunct to the tools of the progressive millwright

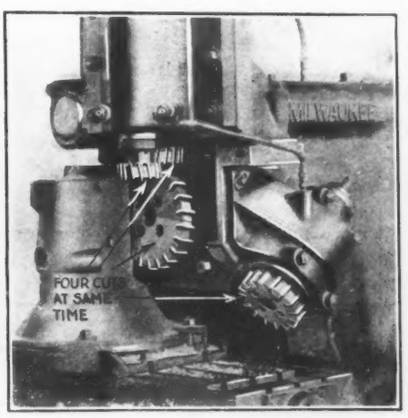


Eccentric Grinding-Wheel

By attaching the wheel to its pulley at an angle the cutting surface has a wobbling motion, preventing overheating

Fits Babbitt-Metal Linings

The two outside parallel rods slide through boltholes of bearing and cap while the center rod is screwed down



Mills Transmission Cases

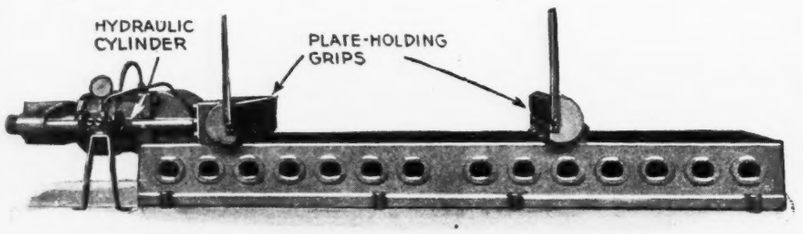
Four milling cutters, each traveling at the same peripheral speed regardless of size, finish four surfaces simultaneously

Hydraulic Stretcher Flattens Fifteen-Foot Steel Plates

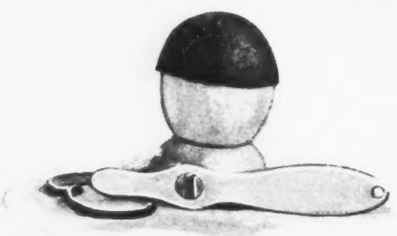
AN English constructional steel firm finds that better results are secured in straightening plate by stretching them in this hydraulic machine than is possible by the use of the familiar mangle - roll. The stretcher can deal with plates fifteen feet long and five feet six inches wide, and by employing the grips seen at the top of the sliding members, the engine will also straighten angle- and T-iron sections.

The principle employed can be clearly seen from the illustration. The plates are held by a combined wedge-and-lever action and may be readily released. The hydraulic cylinder is fixed at one end of the bed-plate and is secured to the working head by steel tie-bolts.

The other working head is bolted to the bed, and may be set in different positions to accommodate plates of different lengths. The machine may be operated for any hydraulic supply, but a small double - throw pump is recommended, so that the pressure may be varied by a spring-loaded adjustable relief valve to suit the power needed for the various plates and sections being stretched.



The steel plates are gripped in a wedge and lever action while hydraulic jacks stretch and straighten them



No Juice Will Squirt with This Orange-Peeler

GUARANTEED to peel an orange without cutting into the fruit, this peeler consists of a short steel blade—shaped like a carpenter's tiny gouge—and a curved, flat spoon.

A groove is first cut around the center of the orange with the gouge, and then the spoon is forced under the skin, loosening it neatly from the fruit without getting juice on the fingers or into the eyes. The body of this tool is made of aluminum.

Why Do We Do It?

Why do we wash in steaming hot water?

WHEN we know that the heat makes the skin tender? It renders cuts and abrasions more irritating. It opens the pores to the very dirt and germs we are trying to eliminate.

Hot water does help thorough cleansing, but physicians and beauty specialists insist that the last step in washing the face scientifically should be a dash of cold water to close the pores.

WHAT DO *YOU* DO?

That you know you shouldn't?

What are some of the familiar practices of every-day life that we all know are stupid and yet that we rarely try to conquer?

Send your suggestions to the Editor

Dials Predict Changes in Tides.

FOR the convenience of mariners making long voyages, the Coast and Geodetic Survey predicts the times of high and low water at every port in the United States from two to three years in advance. The illustration shows the data for Port Townsend, Washington, for 1923 being read from three dials that show the day, hour and minute of every tide change.

© Harris & Ewing

Predicting the rise and fall of tides three years in advance is the duty of this device

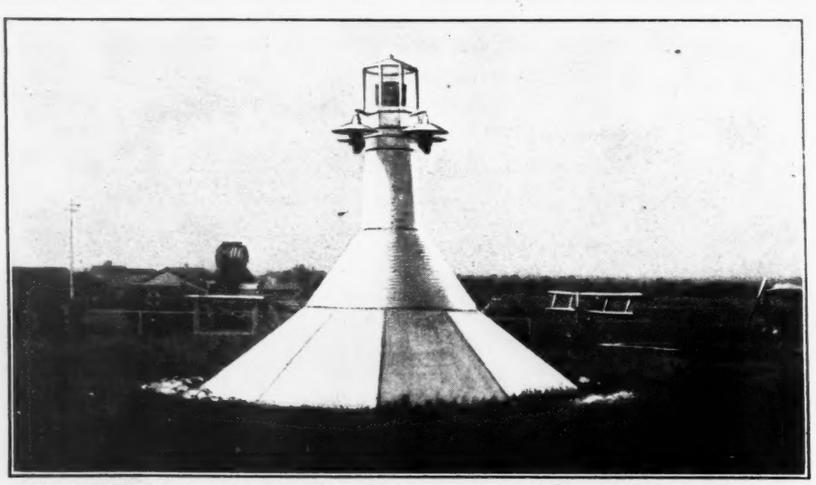
These are compared with the diagram above the dials, since there are two types of tides. In open roadsteads the rise and fall are about the same throughout the day, but in closed harbors entered only by narrow channels the sea rises higher at one high water than at the other. Pilots must know when this highest tide takes place, and the operator is marking this time after the figures of high water supplied mechanically by the tide-calculating machine.

Air Beacon for London-to-Paris Flyers

BEACONS for aviators located in the famous flying-field at Croydon, England, the terminus of the London-to-Paris air lines, are constructed so as to be seen at a great distance without dazzling the pilots by too much glare. Lighthouse lenses of medium intensity are used at the top of the beacon.

This powerful light can be picked up at a great distance. As the plane approaches the field, the pilot sees a white spot of light caused by powerful incandescent lamps reflecting downward and inward on to the white cone.

The beacon is not intended to illuminate the landing-field, but to point out a certain definite spot with the location of which the pilot is already familiar, so that he is able to approach the landing-field in the proper direction. As he starts to land, the field is illuminated by searchlights which reveal objects on the ground in clear relief.



Powerful reflectors light up the white cone as a signal to guide the pilot to the landing-field from great distances

Most One-Ton Trucks Travel Twenty Miles an Hour

HOW large is the average motor truck and how fast does it travel?

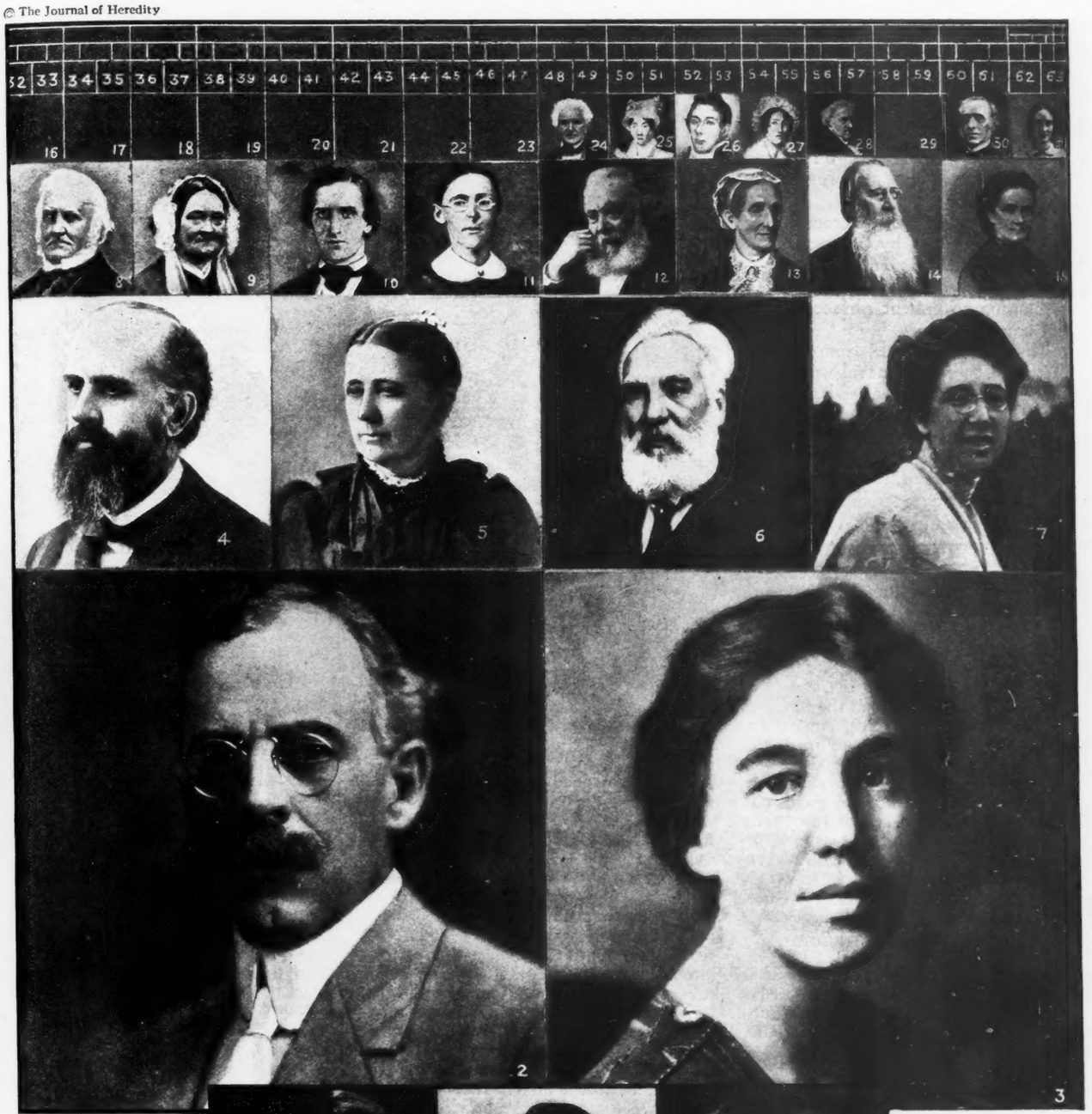
A census by the Bureau of Public Roads on one of the most traveled highways of New England, shows that 40 per cent of the trucks were of one-ton capacity, 33 per cent between one and two and a half tons, 5 per cent between two and a half and three tons, and less than 2 per cent of more than five tons capacity.

On a level stretch of road, the usual speed of trucks was found to be twenty miles an hour. Thirty-seven per cent traveled at this rate or faster, and one ex-speedway driver, who explained that he was in a hurry, was clocked burning up the road at forty-five miles an hour.

Here's the New Style of Family Album

Eugenists Urge Similar Genetic Chart for Every Family

© The Journal of Heredity



Above—(1) Barbara Lathrop Fairchild, Alexander Graham Bell Fairchild, and Nancy Bell Fairchild, children of (2) David Grandison Fairchild and (3) Marian Hubbard Bell, daughter of (6) Alexander Graham Bell

HAS it been your custom to laugh apologetically when bringing out the family album, with its quaint daguerreotypes of grandfather's and great-grandfather's day? Do you know that with the aid of a reducing camera you can compile a pictorial chart that will show the interrelationship of every ancestor, and indicate at a glance the relative influence of each one on the children of today?

The method is based on the principle of heredity that if one takes a square to represent his entire inheritance, one half would represent the influence of his parents, one half of what remained would represent the influence of his grandparents, and so on.

Popular Science Monthly has reproduced the above chart, compiled by David Fairchild, president of the American Genetic Association and son-in-law of Alexander Graham Bell. Mr. Fairchild has long been a leader of the association in its work, and it is because of his interest in this cause that he has permitted publication of the chart, first prepared solely for his personal use.

In explanation: each of the three children above is the product of the entire "square of inheritance." Immediately above them are the father and mother; next are seen the grandparents, and so on. The influence of each progenitor is proportional to the area of the square occupied.

Will Submarine Superdreadnaughts of the Future Sweep the Seas with 12-Inch Guns?

Newest Undersea Battleships to Speed at 21 Knots

By Graser Schornstheimer

ONE of the most interesting discussions growing out of the Washington Conference on Arms Limitation concerns the future of the submarine.

Will the great powers compete—unless prevented by an amicable agreement—in the building of submersible superdreadnaughts capable of blowing all present surface navies out of the ocean?

The following article, from one of of the best-informed naval writers in America, is part of a series which Popular Science Monthly has been publishing to help readers actually visualize the amazing armament developments that will be inevitable if the Washington conference is a failure.—*The Editor.*

The undersea superdreadnaught is in its first stages of development. Japan is constructing a number of submarines of 7500 tons displacement, equipped with four 7.5-inch and 5.5-inch guns. Diesel engines will drive these fighting ships at a speed of twenty-one knots

IS the heavily armed sub-surface cruiser to be the battleship of the future? The submarine was the only naval arm to undergo radical change as the result of the lessons learned during the war, and at least one of these lessons suggests forcibly the reply to the above question.

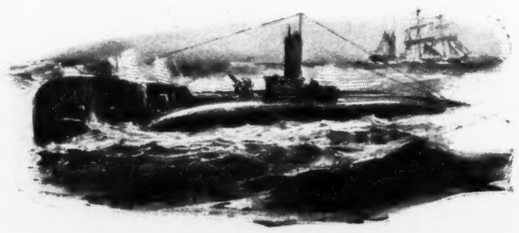
The lesson learned was that the efficiency of the torpedo is still an uncertainty. Too late and to her sorrow Germany made this discovery. Three or more torpedoes were fired for every hit made during the war. While the periscope and the conditions under which the torpedo is aimed are partly responsible for this, the real reason is the inherent delicacy of the torpedo's gyroscope steering apparatus, superheaters, and detonating fuse.

Torpedo Has Disadvantages

Another disadvantage of the torpedo is found in the very conditions under which it must be discharged. Thus, when a submarine comes to the surface, vision through the periscope is obscured by the tiny drops of water falling from its case, and by a light mist that sometimes blankets the high seas. Suppose, despite this, the officer on watch manages to locate an enemy ship. He makes it out indistinctly, no matter how fine his optical equipment. But finally the enemy ship is properly ranged and the torpedo is discharged. Even then the chances of a hit are only one out of three. If it is not a hit, the target will in a moment be maneuvering to such an extent as to render useless the discharge of a second torpedo.

A third drawback to the use of torpedoes is the protective structure of the modern capital ship. Should a hit be made on a battleship, battle cruiser, or large cruiser, comparatively little damage is done, although indeed, the damage will exceed that of an aircraft bomb exploding alongside the ship. In fact, it is claimed that the British *Hood* can withstand ten torpedoes; and with her triple hull our new battleship *Maryland* should be able to withstand six or seven torpedo hits.

The result of these conditions, as I see it, will be the development of regular battleship armament for the submarine, comprising both light and heavy guns. Already, indeed, it is known that Japan intends to build a number of very large submarines of the multigun carrying type. Contracts have been let in Europe for a number of 4000-horsepower Sulzer-Diesel engines. Three engines are to be the surface motors of single large submarines to have a displacement on the surface of around 7500 tons. The surface speed of these boats will be about twenty-one knots, and the surface cruising radius very great. They will be the ideal long-range scouts and commerce raiders.



The efficiency of the torpedo is still an uncertainty, as Germany learned. The smaller submarine is giving place to the heavily armed sub-surface battleship, of which the British "M" type is the first experimental example, designed to "mop up" disabled ships

The armament to be given these ships is a matter of great speculation. But it is known that in addition to the usual submerged tubes, probably of the twenty-one inch type, on the deck will be four 7.5-inch or six 5.5-inch guns, with two or four anti-aircraft guns. These guns will be sufficient to combat the lightly armed cruiser, armed merchantman, or destroyer and, therefore, will be all they will need. Light as these guns are, they forecast the coming of the submarine battleship.

The submarine battleship is, of course, yet to be practically developed, and the British submarines of the "M" type are simply the first uncertain applications of the principle to underwater craft. The first two of these boats, while not exactly failures, are not regarded as entirely successful and have not been ordered to sea duty. The third boat, the M-3, is regarded as successful enough to go to sea with the Atlantic fleet.

Britain's Undersea War-Ship

She is a large vessel, displacing 1600 tons on the surface and 1950 tons submerged. On the surface she is driven by 2400-horsepower Diesel engines, for a maximum speed of sixteen knots, which was actually obtained on the vessel's trial. Electric motors of 1600 horsepower, deriving their power from huge storage batteries, drive the ship when sub-

merged at a speed of 9.5 knots. For surface engines the M-3 carries a normal load of seventy-six tons of oil, insuring a very good cruising radius.

The M-3 will be driven, observe, by Diesel engines, and not by the once much-vaunted steam drive. During the war the steam-propelled submarine proved a failure. In speed it is superior to the Diesel-driven craft, but the British are now re-engining the K-18, K-19, and K-20 with Diesel equipment.

To return to the M-3. Her surface armament consists of one twelve-inch gun, firing a 520-pound shell. (The normal twelve-inch gun fires an 850-pound shell.) A single three-inch anti-aircraft gun is also carried. The vessel is 303 feet long, with a beam of 24.5 feet and a mean draft on the surface of 15¾ feet. She will be the first "submarine battleship" to form a part of a fleet.

Imagine the plight of a battleship that has been severely pounded and forced to draw out of action in sinking condition. Suddenly a speck appears on the surface six or seven miles away and a 520-pound shell comes tearing through her belt. This shell is followed by three or four unexpected torpedoes. Such will be the work of the submarine battleship.

In a certain way, of course, a submarine of this size would be able to take part in a real line-of-battle action. Suppose a fleet of modern battleships is peacefully steaming in column when an equal number of submarine battleships, carrying four sixteen-inch guns each, suddenly appears four or five miles away. They fire three or four tremendous broadsides and then disappear quickly beneath the waves, leaving nothing for the battleships to attack, even if they are able to withstand the big gun and torpedo hits made by the submarines.

All through the ages, "battleship" has simply been the term applied to the type dominant in naval warfare. Who can say that "battleship" will not mean to naval men of the next generation a heavily armed sub-surface cruiser of which the modern submarine is but the rudimentary progenitor?

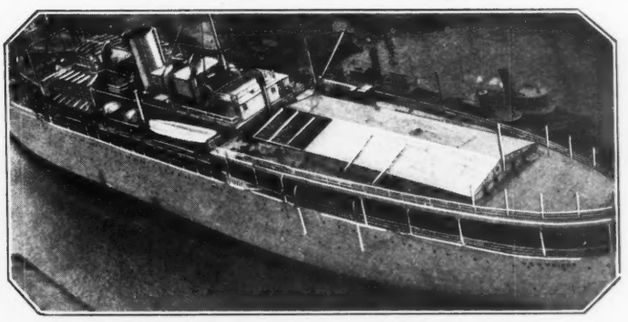
Floating Hangars to Cruise with Fighting Fleets

Masts Will Telescope and Elevators Will Carry Airplanes from Deck to Deck in Newest Mother Ship

THE mother ship of to-morrow will be a vast seagoing service station for aircraft—an intricate floating hangar, machine-shop, and flying-field, capable of maneuvering with any fleet of battleships. In the aircraft tender of the future spacious elevators will lift planes from deck to deck. Masts and pilot-house will telescope into the hull, transforming the top deck into a long unobstructed flying-field. Wind-breaking palisades will offer protection to the flyer from strong sea breezes.

Japan is building such a carrier, the *Hosho*, which will soon be ready to join its fleet of battleships. Other nations are constructing tenders as an essential part of their naval forces. England already has six; France and Italy have a few, while the United States is converting the former naval collier *Jupiter* into an airplane service ship.

The *Hosho* represents the latest advance in this type of naval construction, and is an indication of what may be expected in future development. Ever since the aircraft carrier was conceived, the tremendous advantage of the landplane over the seaplane has forced improvements to permit the landplane to alight on the tender's decks. In the mother ships *Hosho*, *Argus*, and *Hermes* this advantage has been achieved.



The United States balloon-tender "Wright," which will contain space for six kite balloons and complete apparatus for the generation and storage of hydrogen. Machine-shops for the repair of both airplanes and lighter-than-air craft will be included in her equipment. The "Wright's" armament will consist of four 5-inch guns and two machine guns, and the vessel will be manned with a complement of 49 officers and 522 men

The top deck of the *Hosho* is flush from bow to stern. Masts and chart-house telescope into the hull, and the funnels are back of the stern, leaving a flying-deck clear of obstructions.

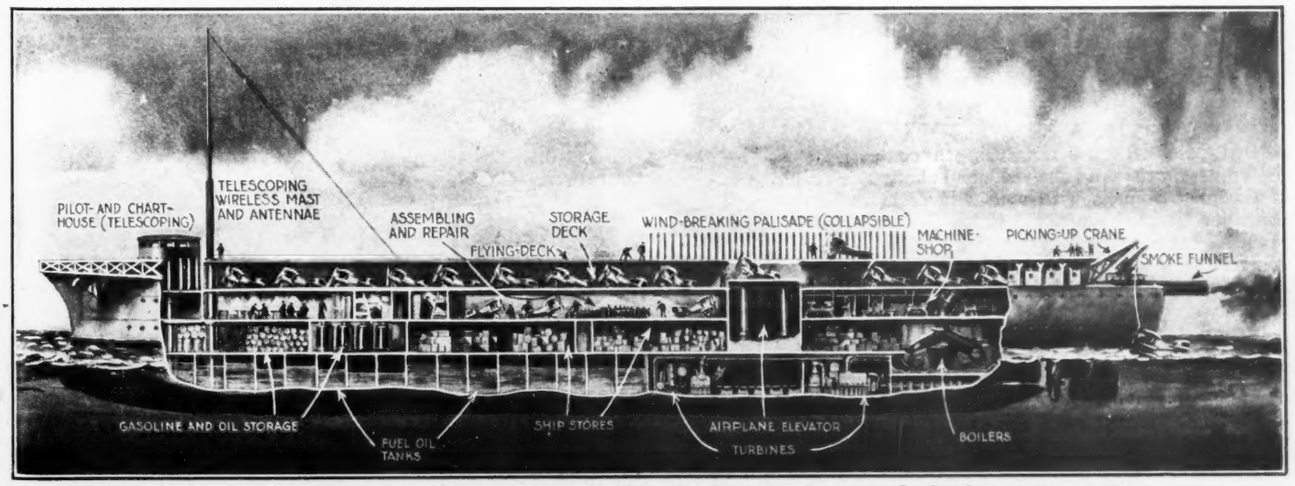
A large elevator, capable of carrying a fully assembled plane, connects the three decks on which the planes are handled. A plane can be rolled into the elevator, which rises flush with each deck, as easily as if it were being rolled from a hangar into a field. When the elevator reaches the top deck, the plane can start straight on its flight as smoothly as from the ground.

To keep the planes stationary on deck when the vessel is moving into a stiff breeze, blast screens have been provided. Without these screens, ready for instant use, a strong breeze or the sudden turn of the ship into the wind might force a plane up kite fashion.

The pilot-house is really a single-story elevator of great size, maneuvered hydraulically.

Planes of at least three types will be carried aboard the *Hosho*—fighting planes to drive off enemy aircraft, spotting planes to spot the big-gun fire of the large war-ships, and a squadron of torpedo planes to attack the enemy's capital ships.

The *Hosho* displaces 10,000 tons with her normal load aboard, and about 13,000 tons with her full load. She will be about 500 feet long, with a beam of fifty-five feet and a normal draft of eighteen feet. Her engines will be turbines and the steam will be supplied by oil-fired boilers. The speed will be around twenty-two knots. Her battery will consist of four 5.5-inch, 50-caliber 82-pounders; two 3-inch, 50-caliber anti-aircraft guns and possibly some deck torpedo tubes. She will be protected with the special anti-torpedo blisters on her hull and by covering armor enough to withstand the fire of smaller cruiser and destroyer guns.



An elevator to carry airplanes from deck to deck, and telescoping masts and pilot-house to permit an unobstructed top-deck flying-field, are part of the equipment of the newest aircraft tender, "Hosho"

This Electrified Satchel Cries, "Stop Thief!"

HOLD-UP men who snatch a satchel from this messenger must make their escape carrying a ringing burglar alarm in their arms. The grip is of ordinary appearance on the outside, except that it is made of steel, but within is a monster bell operated by two specially prepared dry cells, which will ring the alarm continuously for six hours.

If the messenger is held up, he pushes one of two buttons concealed in the handle. The first starts the bell ringing instantly, giving an alarm which can be heard for blocks. If the messenger fears the sudden noise might make the robber shoot, he pushes the second, which delays the alarm until the messenger is from twenty to thirty feet away from the robber.

If the criminal is wise, he will drop the satchel and run away. No sane man would attempt to escape with a satchel in which a bell was ringing, and the noise cannot be stopped without smashing the grip.

A Concrete Gun that Prevents Mine Explosions

COAL-MINERS are now using a concrete gun to spray the walls and shafts of the mine tunnels with a thin layer of concrete. It has been found that this will prevent cave-ins and explosions. The concrete seals the walls from the action of the air, and does away with slacking and its resultant dust.

Coal-dust in the air is the primary cause of mine accidents, and by sealing the walls the infiltration of choke damp and fire damp is also prevented. A thin mixture of cement is used. The gun itself resembles the machines used to spray paint.

THE two most promising substitutes for gasoline are alcohol and furfuraldehyde.

Mop-Wringer Is a Wizard

THIS mop-wringer is a wizard. By applying the mechanical principle of the screw, a child can twist a mop with a force approximating half a ton, which is enough to squeeze out the last drop of water.

Drop the mop in the spiral opening, place the foot on the floorpiece to hold the bucket steady, and turn the handle gently to the right. As the mop is twisted it works its way to the bottom of the spiral, following the wires as if they were the threads of a screw. To remove the mop it must be twisted to the left. In addition to effective wringing, the hands never come in contact with dirty water.

Mopping floors with clean dry hands. The spiral twists the mop and makes hand wringing unnecessary

New Alarm-Clock Buzzes instead of Ringing

INVENTED by Theodore Schisgall, of New York, is an alarm-clock that uses a loud buzzer instead of a bell. The noise produced is loud enough to waken the sleeper, but not great enough to disturb any one else.

Instead of a bell, a U-shaped piece of metal is bolted to the inside of the clockcase so that it is struck by the hammer of the alarm. The vibrations set up are transmitted to the entire case, so that the "buzzalarm" is loud and clear.

Vacant seats are shown on this indicator placed in a theater lobby

No More Standing while Seats Are Empty

AN automatic electrical vacant-seat indicator, whereby the head-usher has a living map of the house constantly before him, adds to the comfort of Los Angeles theatergoers. The vacancy of any seat is registered instantly by a pilot lamp.

The invention consists of a master keyboard installed in the lobby with a light for every seat in the house. The seats are electrically connected with the board, and so wired that when they are occupied the flash remains dark; but as soon as a spectator rises, contact is established by the automatic raising of the seat, and the vacancy is registered on the keyboard until the seat is again occupied and the contact thereby automatically broken. At the same time flashing lights in the aisles indicate rows containing vacancies, which augments the speed with which standees can be seated.

NOW complete to a depth of twenty feet, the Cape Cod canal is big enough to handle the largest coastwise steamships afloat. During the sixty years preceding its construction, more than two thousand ships were wrecked and more than eight hundred lives lost in negotiating the stormy and fog-bound route around the cape. The time saved on the voyages of coal-freighters alone is worth a million dollars a year.

Fish Ladder Allows Trout to Climb Dam

FISHING is forbidden within seventy-five feet of this sluice, for every fish that passes the dam in Bow River, at Calgary, Canada, passes up this fish ladder. A salmon might be able to leap over this dam, or even swim directly up its face, but some assistance must be given to the trout.

In the fish ladder, boards are placed at right angles to the chute alternately from opposite sides. The water rushing down the ladder is thrown from one side of the sluice to the other, forming a series of eddies in which the fish can rest on their way up the face of the dam.

© Keystone View Company

Bicycle Becomes Baby Limousine

DAUGHTER rides in comfort in this perambulator of European invention, which may be taken off its wheels and fitted to the handle-bars of Daddy's bicycle. The frilly sunshade adds a touch of luxury, and baby may pretend she is a proud lady riding in her limousine, while father and daughter both enjoy the fresh air of the road.

The strap in front and two brackets firmly clamped to the fork make the attachment perfectly safe, and as the weight is carried almost directly over the front axle, there is no danger of father's wrists becoming tired.

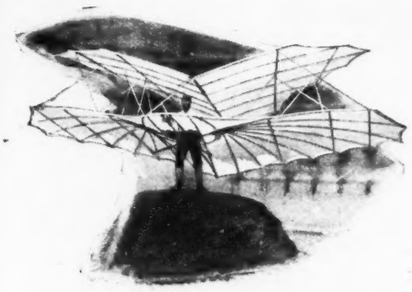
BOOTLEG liquor is so strong it can be smelled over the telephone—at least, a woman of Wichita, Kansas, asked for the arrest of a man so drunk that she said she could smell his breath when he phoned, and, sure enough, the police found him telephoning with a quart of liquor in his pocket at the address she gave. Still, it might have been coincidence.

Otto Lilienthal—the Father of Modern Aviation

JUST twenty-five years ago, this airplane held the sustained-flight record, and its inventor, Otto Lilienthal, was the first man to fly in a heavier-than-air machine. In 1896 he constructed a glider, basing his model on the wings of a bat. There was no engine.

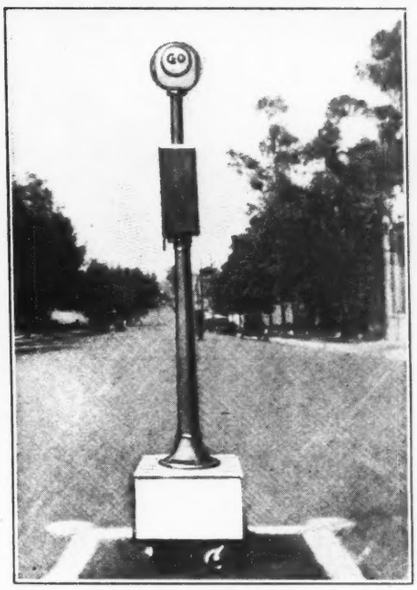
Lilienthal used to jump off the top of a hill and glide to the ground, and as the machine was without ailerons, violent acrobatic effort was required to keep it on an even keel.

Lilienthal finally lost control of the machine and was killed in the fall, but he is undoubtedly the pioneer of modern airmen, and the statue shown in the illustration below has been placed in a prominent position in a Berlin museum as a tribute no less to his courage as to his inventive genius.



A statue of Lilienthal as he appeared when "taking off" with his glider from a hilltop

The Mechanical Traffic Cop



A MACHINE that regulates traffic like clockwork—in fact, with clockwork—has been demonstrated in Los Angeles. The globe at the top of the column contains an electric light, and the box on the shaft contains clockwork that moves the indicator from "Stop" to "Go" at fifteen-, twenty-, or thirty-second intervals, as the exigencies of traffic demand.

The assembly is mounted on wheels so that it may be moved readily to busy points, where it will direct traffic without human supervision.

Takes Photographs while Playing for Dances

SHOWN below is an invention that is a slightly enlarged camera fitted with a motor and parts for playing disk phonograph records.

The feature of the photo-phonograph is that it supplies music for dancing at the same time as it snaps pictures of the dancers. The camera may be used apart from the phonograph and is then, of course, very much lighter. However, the weight

This combination phonograph and camera weighs but twelve pounds. Either feature may be used independently

of the two combined is only twelve pounds, and its size but six inches by seven inches by sixteen inches. The phonograph has a double spring motor, a mute regulator for the tone-arm, and a screw on the sound-box for loud and soft adjustment.

Molds Rectangular or Oval Concrete Pipes

RECTANGULAR or oval concrete pipe may be molded by the machine invented by Rijkent Last, of Enkhuizen, Netherlands. The mold is mounted on a table which is rotated at a fixed speed. Meanwhile, the rammer is moved up and down by a crank on the same shaft.

A cam shaped to correspond with the outline of the particular form of pipe being molded is connected by gearing and shafts with the rammer so as to control and guide its operation in shaping the pipe to the desired form. The function of the rammer is, of course, to press the material into the mold.

An Ice-Shaver and -Cracker

THIS ice-shaver and -cracker that does not scatter chips over the entire interior of the refrigerator was invented by John B. Zorin, of Kansas City, Missouri.

It consists of a boxlike instrument having a curved rear portion to fit the palm of the hand. The ice is shaved with the knife at the forward end. The shavings

The chips of ice are forced back into the handle of the ice-shaver, which can be opened when filled

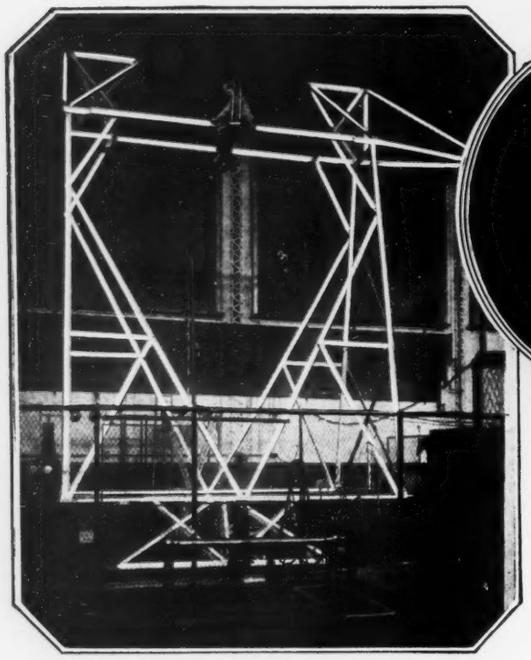
fall into the box, from which they are removed by sliding back a pivoted cover.

A resilient blade is mounted within the device just above the cutting-blade, and this springs back when the cutting is in progress, thus increasing the opening through which the cracked ice enters the box.

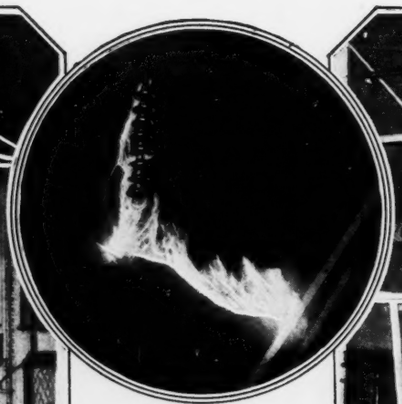
On the recovery stroke, however, this blade springs back to its original position, closing the gap at the cutting end of the blade and thereby preventing the ice from dropping out. This blade can also be utilized as a pick to break off the ice in larger pieces.

THE Amazon River and its tributaries have fifty thousand miles of navigable waterways.

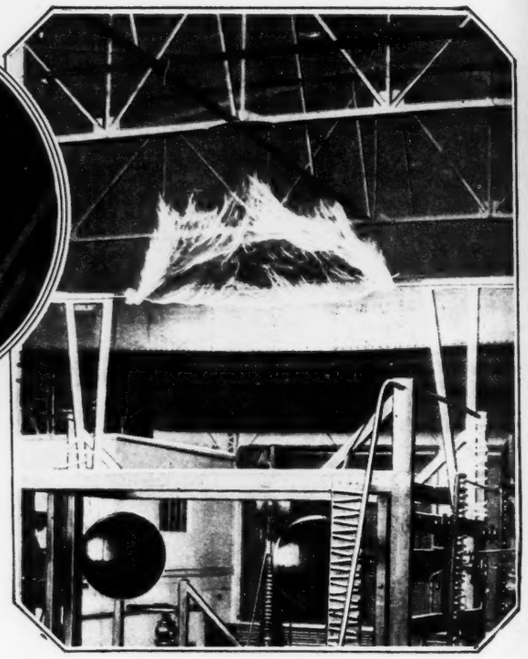
A Million Volts! Can This Current Be Used?



The high-voltage transmission-line tower in high-voltage laboratory at Pittsfield, Massachusetts, giving an idea of the laboratory testing apparatus used for this experiment



High-voltage insulator test at about 600,000 volts, showing spark-over of insulator from wire to tower, the arc jumping a distance of six feet



The first million volts ever produced jumping across a needle gap of nine feet at the high-voltage engineering laboratory of the General Electric Company, at Pittsfield

A MILLION volts! One fiftieth of the terrific energy of a lightning-flash! The recent accomplishment of the General Electric Company, in generating a current of this pressure has set engineers thinking more seriously over the still practically insoluble problem of transmitting such voltages for profitable commercial use.

As the voltage is increased, the diameter of the conductor must be increased with it. For a million volts this means a conductor of at least four inches in diameter. If it were necessary that the four-inch conductor be solid, this fact would probably kill all chances of super-high voltages ever being used, but, strange to say, the four-inch conductor may just as well be a pipe or tube made of thin sheet copper. The pipes could be supported between the high towers by a cable of high tensile strength passing through its center.

The latticed poles of transmission lines must be built high enough to allow the wires to be strung at least fifteen feet apart and a hundred feet above the ground. But, even then, some of the electricity, in the form of a bluish haze, will leave the wires and skip off into the surrounding air.

If the use of a million volts is eventually found practicable, it will mean cheaper electric lights, cheaper power for heating homes, for cooking, and for performing the numerous household tasks. Current may then be transmitted from a station in Alaska to homes in San Francisco, since engineers figure that power can be sent a mile for each thousand volts generated.

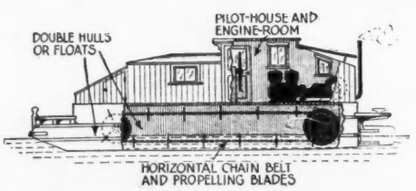
Boats with Caterpillar Propulsion Can Navigate Shallowest Rivers

CATERPILLAR traction has been adapted to boats by Maxence Isnard, a French inventor, not with the idea that it will ever replace the marine propeller on sea-going vessels, but to permit flatboats to navigate streams too shallow for tugs equipped with screws to negotiate.

Isnard's propulsion system consists of an endless belt carrying paddle-blades on its outer surface, which runs over wheels about five feet in diameter, placed thirty feet between centers. With the exception of the paddles, this is precisely the same as the drive of a caterpillar tractor. It is run in the usual way by a ten-horsepower gasoline motor.

The effect is the same as that which would be produced by oars. The paddles are placed six feet apart, so that each works without having its efficiency reduced by the disturbed water following the preceding blade. The driving wheels are placed so that the paddles will work in a foot of water.

To prevent the blades from being broken by accidentally touching the bottom, the tractor is placed in the center of the hull, and floats are brought down on each side, extending to a point that is slightly below the paddles.



A chain belt equipped with paddles and driven by a small gas-engine propels the canal-boat

In tests carried out on this caterpillar boat, a speed of six miles an hour was attained. Shallow streams may be negotiated without fouling

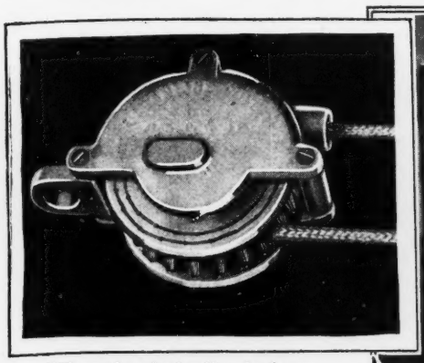
In a test made on Lake Bourget, the caterpillar boat developed a speed of six miles an hour. Its tractive force, as measured by a dynamometer, amounted to five hundred pounds.

Electric Locomotive Needs No Engineer

FRENCH engineers are said to have perfected a system of communication between two electric engines used to drive a single train, whereby no engineer is required in the second cab. The locomotive at the head of the train produces a secondary periodical current of low voltage but high frequency, which is superimposed on the regular circuits.

A selector in the engine in the rear is operated only by this superimposed current. The movements of the selector operate the controller and braking equipment of the engine in the rear cab so that any change made of the forward controls is automatically repeated in the rear. The device is to be used on trains traveling over mountainous country.

Time- and Money-Savers for the Household



When the clothesline is drawn over this pulley, it is automatically cleaned by the brushes with which the pulley flanges are studded all around the inside

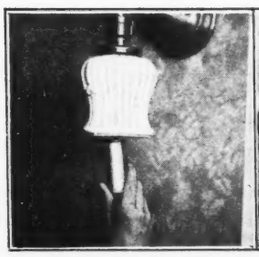
Put your meat in this broiler, cover the bottom of the gravy-pan in its lower part with water and let the heat of your gas-stove do the rest

These tongs are for lifting hot tins out of the sterilizer, preserve-jars out of the boiler, and for handling other hot objects around the stove

Three prongs, which form part of the socket fixture, engage the rim-flange of the diffusion bowl and hold it firmly by spring action

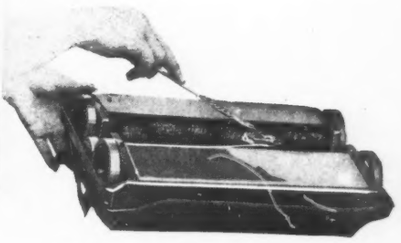
Grating nutmegs usually means abrasions of the knuckles. With this machine the possibility of injury is practically eliminated

The fringe of the mop is attached to a tape, the ends of which are fastened together around the holder with a snap-button

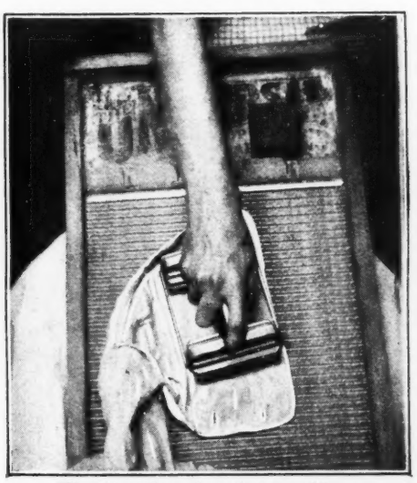


By means of this socket extension it is possible to attach the plug of an electric iron without removing the ornamental shade

The air compression required for this atomizer is obtained by a miniature air pump with an ornamental plunger with a cloisonné knob

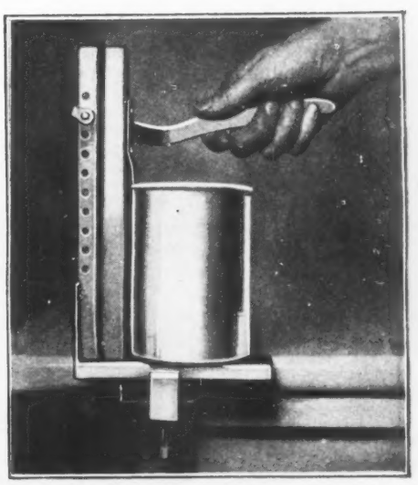


With a tool made of a row of wire hooks shaped like cat's claws, the brushes of carpet-sweepers are easily cleaned



The "washer-skate" here illustrated is a small device consisting of two corrugated wooden rollers mounted in a frame with a handle. It saves the knuckles

Here is an electric water-heater. The heater is covered by an insulating jacket

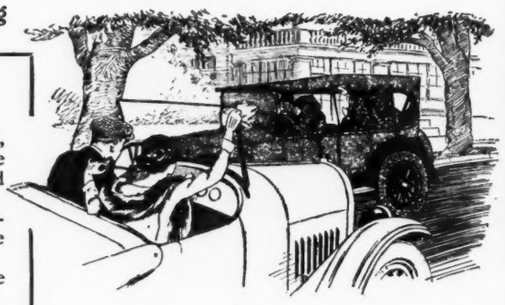


This can-opener may be attached to the kitchen table or a wall bracket, and the slanting cutter is worked up and down by a lever while the can is turned

How Quickly Can You Solve These Brain-Testers?

New Puzzles that Are Easier than They Look

By Sam Loyd, the World's Puzzle King



Twenty-Five Dollars in Prizes

EDUCATORS say that puzzle-solving is the best kind of mind-training—best, because it comes as sport instead of drudgery. As proof of this, consider the fact that Sam Loyd's most faithful puzzle fans have been inventors, engineers, and business men.

A first prize of $10 will be awarded the reader who sends in the best set of correct answers and analyses covering the four problems on this page; a second prize of $5 for the next best set; and ten other prizes of $1 for the ten next best sets.

Answers must be received not later than February 8, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

By "best" is meant absolute correctness of solution—then, if other points must be considered, clearness of analysis. Mr. Loyd's decision must be considered as final. In case of a tie, each competitor will be awarded the full amount of the prize tied for.

Answers and names of the prize-winners will be published in the May issue.

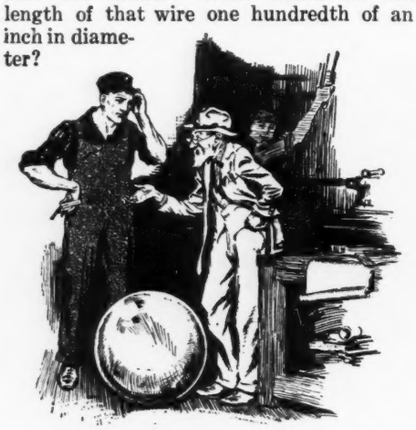
Can You Convert the Sphere into Fine Wire?

A MACHINIST, who makes a specialty of building models for inventors, has witnessed the practical working out of many conceptions that at first inspection would have convicted their authors of mental unsoundness.

For example: A large sphere of whitish metal was carted to his shop the other day, escorted by a mysterious old fellow who explained what he wished done with it.

The sphere measured twenty-four inches in diameter and its owner wanted it converted into wire thread one hundredth of an inch thick. The establishment was not equipped to tackle the job, but some of the men, out of curiosity, calculated what would be the length of that wire if the twenty-four-inch ball were spun out as required without any waste of material.

It is a simple problem that yields to common-sense methods and a little ingenuity, so we will ask our problemists to produce the answer. What would be the length of that wire one hundredth of an inch in diameter?



At What o'Clock Did the Browns Meet the Joneses?

ONE night last fall, the Joneses started out in their new car to call upon the Browns, and when they reached the domicile of the latter, learned that the Browns, having been gone just eleven minutes in their car on the way to the Joneses, must have passed them on the way, so the Joneses turned about and proceeded homeward, observing closely all other cars that were met.

Now, the Browns, it appears, reached the Jones cottage fifteen minutes after the departure of the Joneses on their way to the Browns, so the Browns, too, reversed and sped homeward.

On their return trips the friends—being this time on the lookout for each other—met on the road at a point midway between their homes, at exactly four o'clock.

From this bit of road gossip what time was it when the Browns left home to drive over to the Joneses?

Of course it must be assumed that the two cars maintained their respective speeds throughout, and traveled the same route.

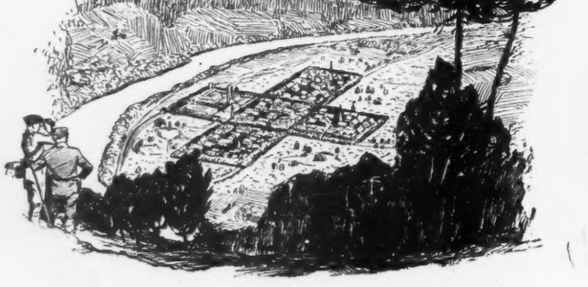
How Much Fencing for This Town?

DESCRIBING the model town he wants to found, a city-planner says that the boundary-line of his Utopia would be in the form of a Greek cross, embracing five squares, such a one as is illustrated below.

When asked as to its proposed size, he replied:

"I plan to have the dimensions of the city such that the number of running miles enclosing it will correspond to the number of square miles in its area."

Let us determine the length of fence it would require.



What length of fencing will the city-planner need to surround the town of his dreams?

Voting for a Bus-Route

IN establishing a bus-route between Union and Central railway stations, the transit company left the selection of a route to a vote of the property-holders on the sixteen blocks forming a large square of which the stations were diagonal corners. A condition that the company made was, that the chosen route must not be longer than that shown in the sketch by a dotted line. How many routes, all different in some respect, but all eight blocks long, would it have been possible to vote for?

How many different routes—each eight blocks long—can be laid out on this street map?

How You Can Receive Radio Messages with a Bit of Wire Fencing

Odd Experiments with New Wireless Antenna that Is Inexpensive and Requires No "Ground"

By Armstrong Perry

The author of this article tried out a condenser antenna made of two window-screens insulated with books. Immediately he heard a long-wave-length station, three hundred miles away

TWO pieces of chicken wire, stretched horizontally between two insulated supports, have been found by the Bureau of Standards to possess all the advantages of the loop antenna without several of the latter's disadvantages. With this a reality, one of the last obstacles to a wider participation in radio enjoyment by the amateurs of America has been surmounted.

According to Hiram Percy Maxim, there are over 250,000 radio amateurs already receiving benefit from the increased activity in wireless. Football and baseball scores, weather forecasts, market reports, election returns, the correct time, and general news from all parts of the world, are some of the items picked up daily by the quarter million radio enthusiasts. And that does not complete the list by any means. Radio concerts, both vocal and instrumental, are being given with semi-weekly regularity. In some sections of the country sermons and church music are delivered broadcast to whosoever has a radio receiving station to catch and enjoy them.

Construction of Loop Antenna

It was only a short time ago that a receiving outfit was designed so sensitive that a loop of wire four feet square would gather enough energy to render sounds perfectly clear in the ear of the receiver. The heart of this set was an audion bulb or vacuum tube that looks like an electric-light bulb, but contains in addition to the filament two other metal parts called the *grid* and *plate*.

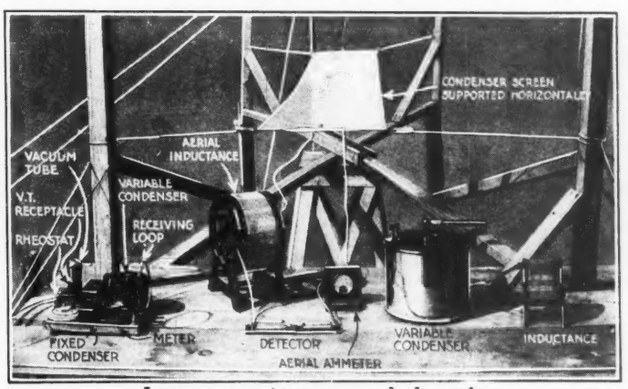
By turning electric currents of different voltages into the filament and plate and passing energy gathered from the intercepted radio waves through the bulb, the electrical waves sent out by the transmitting station are translated into intelligible sounds exactly similar to those made at the sending station, whether they were in the form of music, conversation, or the dots and dashes of the Morse code.

Yet the loop antenna had certain drawbacks. It was difficult to make, and after completion it had to be handled with great care lest the turns of wire became bent or jammed. In dismantling for storage, the task of unwinding the coils of wire was a tedious one.

Undoubtedly with these facts in mind, the Bureau of Standards has developed the condenser antenna working on a principle different from that of either the loop or straight-wire antenna.

Those who have already taken their first steps in radio know that the receiving station must be "tuned" to the transmitting station that it is desired to hear. This tuning is accomplished by a balancing of two electrical properties—inductance and capacity. Inductance always lags and capacity rushes ahead. The radio amateur merely turns the two or three knobs attached to his apparatus and gets the results whether he knows what is happening inside or not.

The loop antenna has a large value of inductance that is balanced by the capacity of condensers in the tuning apparatus,



Instrument layout used by the Bureau of Standards to test the adaptability of the condenser antenna made of fine-mesh copper screen. Half of the antenna is not included in the photograph

whereas the condenser antenna has a large value of capacity and is balanced by the inductance of wire coils in the tuning apparatus. But this difference means less to the average amateur than the fact that he can readily make a condenser antenna out of two pieces of chicken wire or two window-screens or two anything that are flat and made of metal and that can be suspended parallel with each other with a reasonable amount of air space between.

The pictures on this page tell the story better than words. Wire netting of various sizes has been used varying from six feet up to thirteen feet square. These screens were suspended from a specially built frame, but they could be hung from trees or from the ceiling or from anything else as well, so long as they are insulated so that the energy that they pick up will all go into the receiver and none of it escape.

Hanging the screens vertically instead of horizontally reduced the strength about 75 per cent.

It has been determined that the circuits used with an ordinary antenna are equally satisfactory with the condenser antenna. But for convenience and quick tuning a special circuit was devised that required but one adjustment for any given wave length after the vacuum-tube detector was set in operation.

No tests were made using the antenna for transmitting, but it should prove very effective because its low resistance permits the radiation of most of the energy generated.

It Has a Military Value

This new antenna may be found of the utmost importance in military operations. The work of unrolling two such screens as used in this experiment and making the necessary connections can be accomplished in a minute or two.

Like the loop antenna the condenser antenna requires no ground connection, which is an advantage, as a good "ground" is often difficult to find.

The investigators concluded that "the condenser antenna of small dimensions has a decided advantage over the coil antennas when wave lengths under 250 meters are employed," but that the larger screens needed for successful reception of longer wave lengths would render the outfit less easily portable.

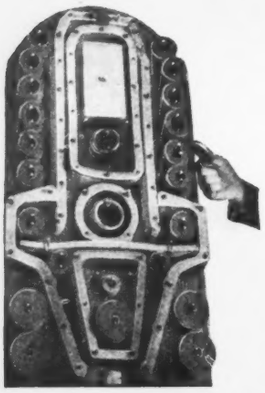
Using a Window-Screen Aerial

"WHEN I heard of this condenser antenna, I set out at once to test it from the amateur's standpoint. I yanked out a couple of ordinary japanned window-screens. One I laid on a pile of books on my study table. On top of this I piled more books and then laid the second screen on top of the heap. Then I scraped bare a small place on each screen and attached copper wires leading to my long-wave regenerative receiving-set.

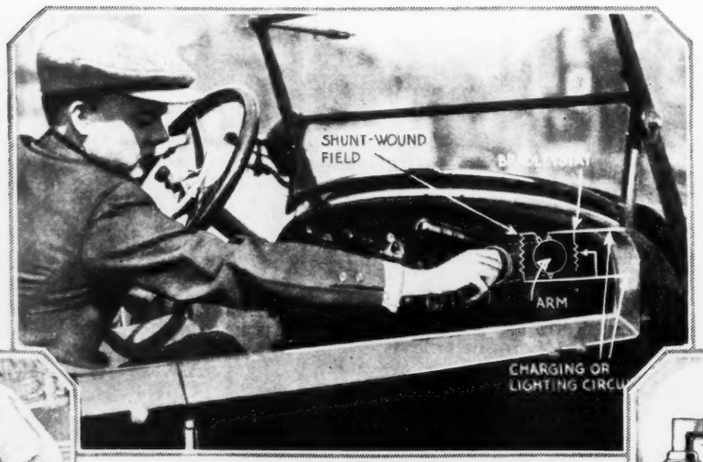
"I adjusted the knob for 600 meters. Da de, de da, d'd'd'd. NAH, the New York navy radio station, was just signing off. It was fainter than it is when I receive it over my 110-foot single-wire antenna, but it was readable.

"Shifting my inductance switches, I went up to the extremely high waves. By turning one knob I could then cover a range of from 10,000 meters to 24,000 meters. An arc-station signal came whistling in, faint but clear. Soon I was able to identify it as coming from WSO, an experimental station at Marion, Massachusetts."—*Armstrong Perry.*

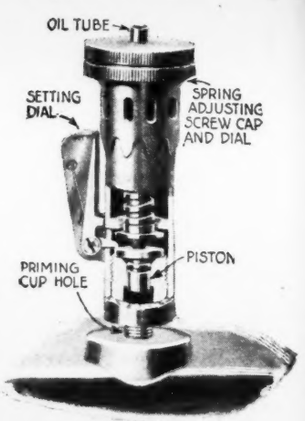
A Variety of Devices that Will Help You Solve Your Motor Problems



Every gasket needed in the usual run of repairs, in plain sight and assorted by sizes, saves time in the busy garage

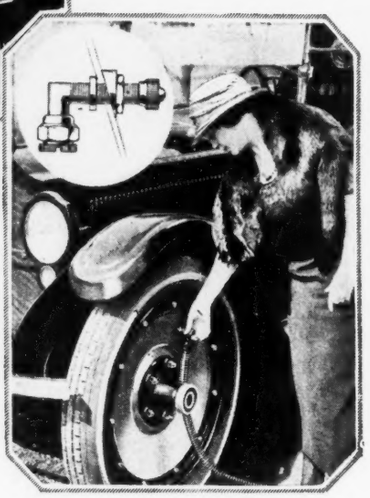


Overcharging storage batteries is prevented by a patented device by which the rate of charging can be regulated from the driver's seat. The connections are such that the ammeter indicates the amount of current flowing into the battery



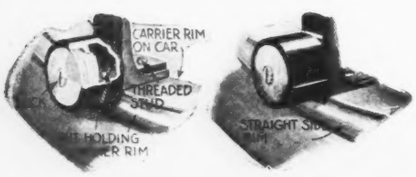
Internal cylinder pressure in gas-engines is recorded on a revolving drum by a piston acting against a coiled spring

Compressed-air grease-guns can be made from a two-quart Mason fruit-jar by soldering two metal tubes into the screw-cap

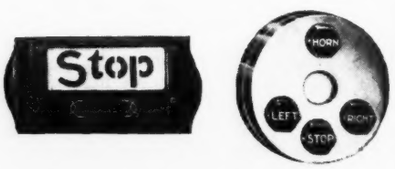


A right-angled valve extension allows tires mounted on solid steel wheels to be inflated from the outside in the usual way

A bolt sliding into a lug on the steering-wheel, locked by a four-number combination, makes theft impossible

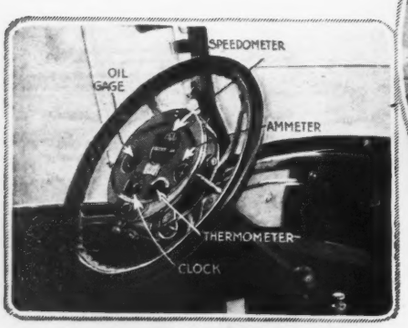


New lock for spare tires prevents theft by a metal barrel that fits over the nut on the stud of the tire-carrier

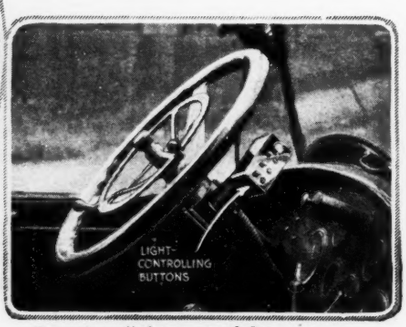


Illuminated signs on the rear operated by push-buttons on the steering-wheel gives the car behind warning of your next move

Geared to the wheel, the searchlight always illuminates the path directly ahead of the car, permitting the driver to give her undivided attention to the road during night driving



All the instruments usually placed on the dash can be mounted on the steering-wheel, where they are always under the driver's eye



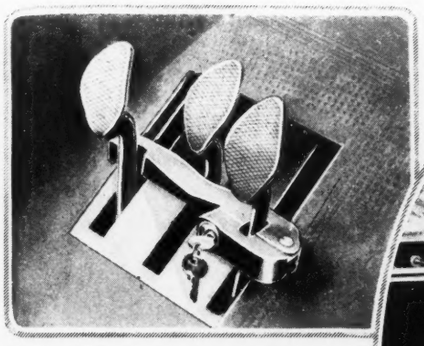
Complete light control from a compact keyboard obviates driving with one hand while groping about the dash for the right switch

If You Need Help when You Overhaul Your Car

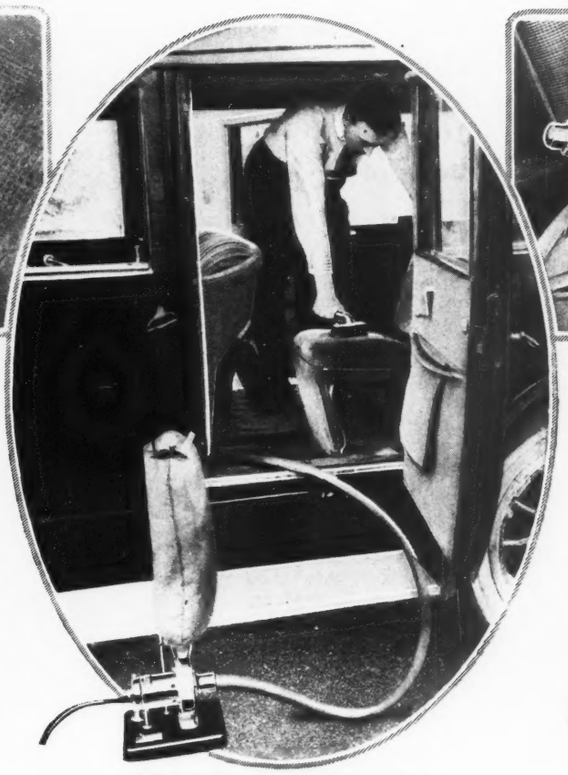
POPULAR SCIENCE MONTHLY publishes each month two pages of new and improved attachments and accessories designed to bring the old car up to date and to give the new car that touch of individuality that distinguishes it from other automobiles of its kind and makes it indisputably "your car."

Remember our Service Department. If you have questions concerning your car that you would like to have answered by an expert, write to our Automobile Editor. Helpful answers are given to all inquiries; see page 79.

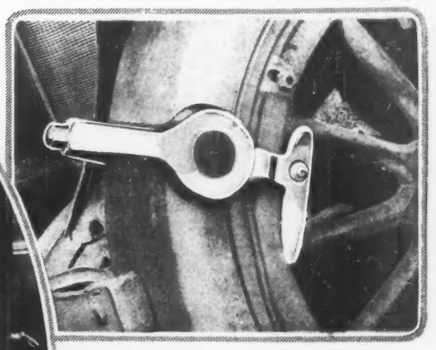
© Keystone View Company



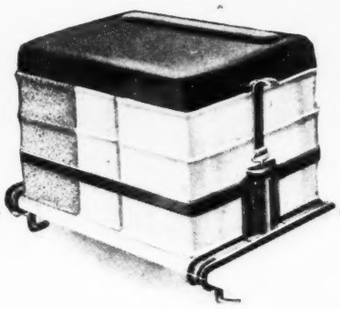
The forged steel arm is woven between the three pedals and locked around the brake-pedal, making any movement of the car impossible



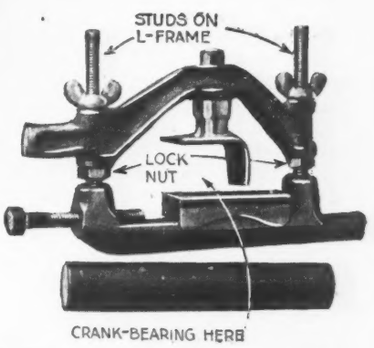
The cleaner attached to a footboard is placed outside the car and a tube carried into the car. A swiveling nozzle head enables any part of the upholstery to be reached



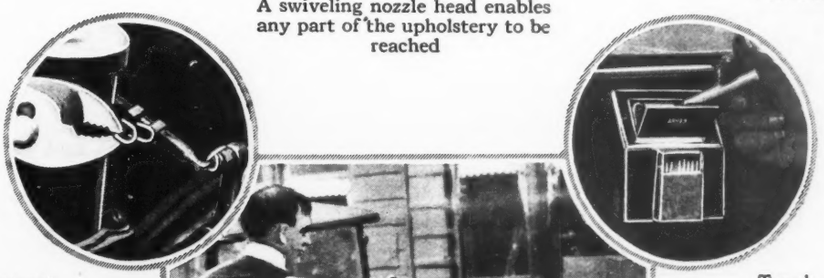
If the car is moved while the device is locked, the piston is depressed and sounds a klaxon horn at every turn of the wheel



Attached to the running-board the unit shown above carries extra water, oil, and gas. A spout in the tank does away with spattering and wastage



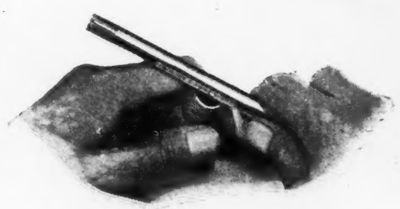
Above is a tool for home garage or small shop. The wing-nuts clamp the bearing, while the cutting edge smooths the surface



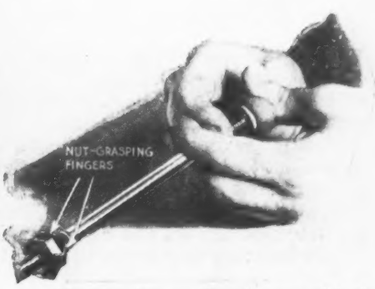
If the accelerator rod becomes worn and drops out of place, a paper-clip wound around the ball-and-socket joint will effect a temporary repair

Touch a button and the lid flies open revealing a receptacle for the ashes and a supply of matches. It can be installed on any dash

The lower end is screwed into the spark-plug bushing, and the gage at the upper end registers compression pressure, piston-ring fit, and general condition of valves



A pocket tool with a peculiar head to loosen the carbon and a file to clean out the center of the plug

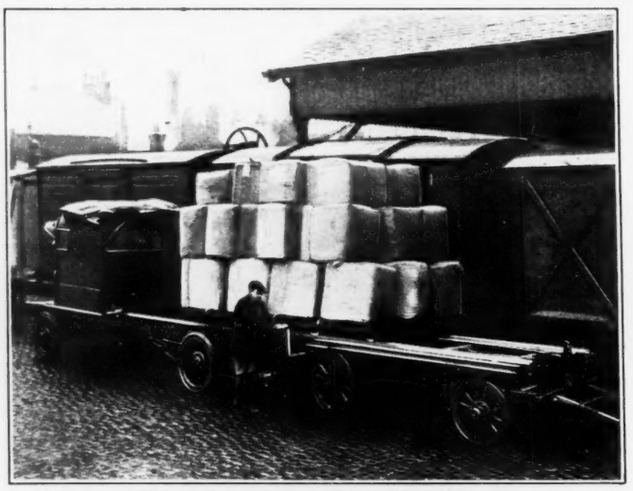


By pressing on the plunger with the thumb, the metallic fingers at the opposite end open to grasp inaccessible nuts

Detachable Truck Body Speeds Up Freight Handling

LOADING trucks in freight-sheds is being expedited by the substitution of a "flat" on rollers for the ordinary truck body. This flat is mounted on a track, so that it can be rolled off the chassis on to a similar track installed on the floor of the warehouse or on a horse-drawn wagon.

The purpose of the invention is to keep the trucks busy delivering goods. Idle time while the truck stands waiting for a load is reduced to a minimum, and by placing the flats directly in the railroad cars, or alongside the door, the goods are moved only once by hand. After being placed on the flat, the load is moved by machinery, a truck-load at a time.



The man is turning the capstan that draws the "flat" from the truck on to a stationary vehicle from which it can be unloaded without detaining the truck

The flats consist of a strong wooden frame mounted on small grooved steel wheels. These wheels fit into a track that runs from the car sidings to the truck-loading platforms. A similar track is bolted to the truck chassis, and the driver backs into a saw-toothed loading-stand so that the tracks will be as nearly as possible in alinement.

Loading-Stand Has Movable Frame

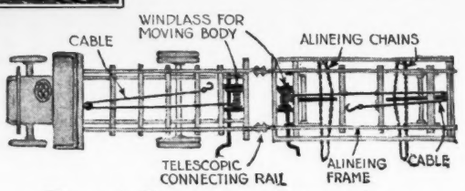
As the inventors of this system realized the tracks would never be exactly in line, they perfected a clever device for overcoming the difficulty. The loading-stand is equipped with a movable frame consisting of two parallel rails and an arrangement of pulleys so contrived that by pulling on a chain the rails can be swung to either side as desired. The lateral adjustment may be made over a distance of ten feet, so that if the truck is brought up sideways or out of line the alinement may be rectified without difficulty.

The coupling between the truck and the loading-stand is accomplished by a pair of hinged extensible arms permanently carried at the ends of the frame mounted on the truck. These telescopic connecting pieces can be hooked on the ends of the rails on the adjustable frame. Since the arms are hinged vertically as well as horizontally, the connection can be adjusted for any difference in height between the truck and the loading platform.

A windlass mounted on the truck is then utilized to haul the flat on to the chassis. It is secured in place by hooks or clips, and the truck is ready to set out on another trip. The whole operation has taken less than a minute. The equipment is simple, cheap, and easy to install. By its use both drivers and freight-handlers work steadily, neither having to wait for the other, and the full capacity of a fleet of trucks can be obtained by the shipper.

Where Time Is Saved

Where large numbers of loads are to be delivered to one place, the first flat with its load can be run off the truck on to the receiving platform, and the load removed while the truck itself is bringing in another flat.



The windlass arrangement that draws the flats on and off the waiting trucks

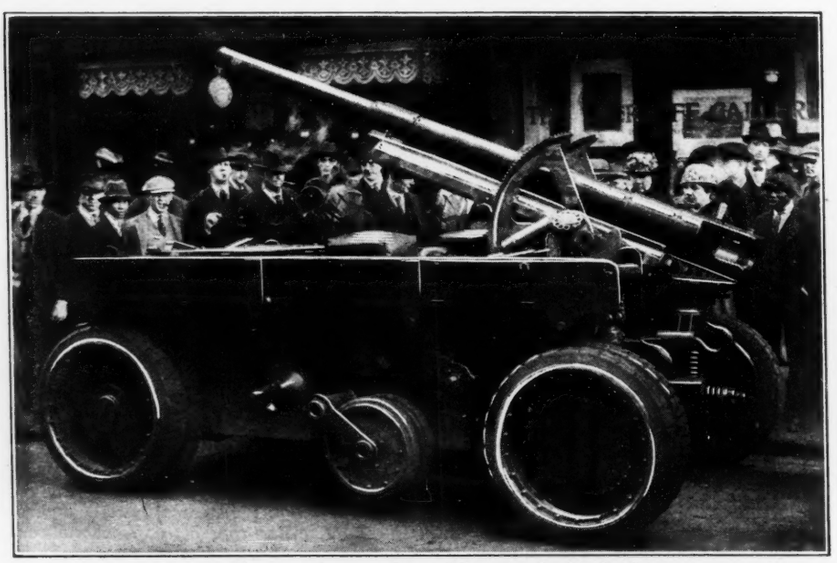
If necessary, horse-drawn vehicles can be used in conjunction with trucks, and the loads transferred in the street without difficulty. The trucks handle the long hauls, and horses the door-to-door deliveries.

Artillery Exceeds Speed Limit

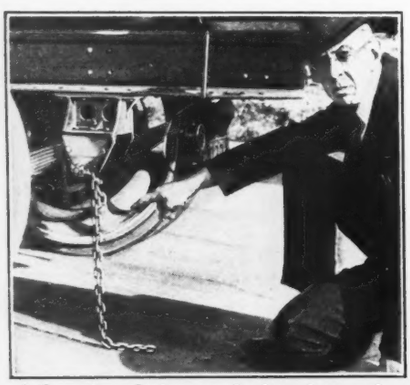
THIS new American mobile "75" rifle and its mount may weigh six and a half tons, but traffic cops along its line of march from New York to Washington would have been justified in arresting the driver for exceeding the speed limit. On ordinary roads the truck will make thirty miles an hour, which is mobile artillery indeed. The two hundred and fifty-one mile trip took only seventeen and a half hours.

Caterpillar belts are attached over the rubber-tired wheels when the gun is moved across rough country. The army designers have constructed this mount so that light artillery may be held in reserve and rushed to weak points on the line as it is called for by the infantry.

The mount is adapted to a high angle of fire, so that it can be used as an anti-aircraft piece.



By placing caterpillar treads over the rubber-tired wheels this army truck can leave the road and travel across country with its six-ton "75" rifle



A dragging chain attached to the truck-frame carries off any static generated by filtering gasoline

Static Grounded through Dragging Chain

BECAUSE gasoline, a dry liquid, generates static electricity, it has been necessary to equip a type of fuel-delivering tank-truck with ground chains.

Usually the driver drops the chain when he gets out to deliver fuel. It is the flowing of the gasoline through the outlet pipe that generates the static electricity. Many of the truck-drivers let the chain dangle all day for fear they may forget to ground it.

TRACING migratory birds by attaching metal bands to their legs has been practised since 1710. Hunters finding such birds should communicate with the United States Bureau of Biological Survey.

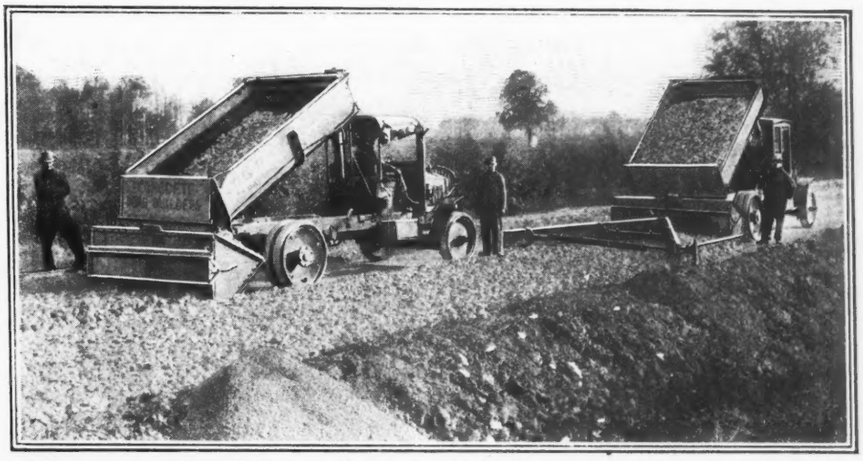
Auto Windshield Visor Works Like Window-Shade

HANDY as an umbrella, and instantly adjusted in any position, a sun and rain curtain that fits outside the windshield of an automobile acts as a visor to protect the eyes of the driver from sunlight, rain, and the glare of headlights. The shield is made of top material, painted green on the under side and black above, with a heavily folded and stitched selvage on the edges to give wearing quality.

It is built along the lines of a window-curtain, so that it may be instantly rolled back out of sight against the top of the windshield. The angle may be adjusted by thumbscrews at the sides.

The curtain can be rolled back to the top of the windshield

Truck Attachment Spreads Crushed Stone



AN even layer of crushed stone is spread upon the roadbed by the driver of this truck as he dumps his load. There is no follow-up crew of stone spreaders, no hills or hollows in the operation. The stone goes through the spreader only when the truck is moving, insuring an even depth and a uniform width. The attachment is hitched to the truck axles and is dragged behind the car as it moves ahead in dumping the load.

Two trucks equipped with spreader attachments can make short work of laying a roadbed, each truck spreading one side of the road, thereby saving much time and the work of a crew of laborers.

Write to Us About Your Motor Troubles

If You Have a Motor-Truck or Automobile Problem, Let the Automobile Editor Solve It

To Increase Gasoline Mileage

Q.—How can I get the maximum gasoline mileage?—B. C. M., Albany, N. Y.

A.—Gasoline economy depends on small things, as does economy in business or anywhere else. The first essential is an engine with tight valves and pistons. Next to that is the use of an economical carburetor adjusted to give a rather lean mixture. The car should roll freely and the brakes should not drag, nor should clutch-slipping be tolerated. The advance of the spark should come in for careful attention. It should be advanced just enough to give maximum power. No more and no less. There should be no leaks in the fuel system. Finally you should have a measuring stick or a gage that shows the tank capacity in gallons and should see that whenever you purchase gasoline you get full measure.

Treatment for Worn Cylinders

Q.—I have a 1917 car with cylinders that are worn badly at the top. Would you advise lapping them?—S. E. W., Mt. Carmel, Ill.

A.—You will find reboring much more satisfactory and the chances are it will not cost any more, inasmuch as you plan to dismantle your engine anyhow.

Steel *versus* Wooden Wheels

Q.—Are one-piece transmission bands for Fords satisfactory? I refer to the type that can be attached without riveting. Are steel wheels satisfactory? I am told that they are harder on tires and bearings than wooden wheels, because their resiliency is less.—M. A. F., Broken Bow, Neb.

A.—The Ford transmission band which you have in mind is undoubtedly the type that replaces all three bands commonly employed, and that may be put in place without removing any of the mechanism. We have not had the opportunity of testing these bands, but we have made frequent inquiries of users, and the reports invariably have been satisfactory. In addition to their ease of replacement, an important advantage claimed for them is the fact that they will not chatter.

Steel wheels are not noticeably harder on tires or bearings than are wooden wheels. After all, the difference in resilience of the two types is small, and the effect of this difference of resilience is still smaller.

Let's Hear about That Gypsy Motor Trip

WERE you one of those who answered the call of the road during the summer?

Gypsy motorists have been writing to us, telling of their experiences on their camping-trips—how much their trips cost, where they went, what lessons they learned that will be profitable to others next year, and what automobile camping equipment they purchased or improvised.

It's not too late for you to write to us, too, telling of your experiences. For the most interesting and informative letter, $35 will be paid; for the second best, $15. Letters must not be more than 500 words long, and must be received on or before January 10, 1922.

Differences in Motors

Q.—I am planning to build an electric car, and would like to know whether the Ford running-gear would be satisfactory. How powerful an electric motor shall I require, and what is the difference between electric motors built for heavy loads and for common loads?—G. H. M., Norwich, Conn.

A.—The Ford running-gear will be quite satisfactory. It is light, cheap, and simple. A 2½-h.p. electric motor is ample for running a rebuilt Ford 20 to 25 miles an hour. In asking the difference between an electric motor built for heavy loads and common loads, we believe that what you were thinking of is the difference between industrial motors and motors such as are used on railroads. The latter are almost invariably series wound, where industrial motors are shunt wound, assuming in both cases that direct current is employed. You should obtain a series-wound motor for your car.

Keep Your Oil Reservoir Full

Q.—How often should oil be put into the engine?—O. H. H., Hudson, N. Y.

A.—More engine trouble is caused by lack of oil than anything else. It is a common occurrence for an engine to be operated until the oil reservoir is nearly dry. With good luck this can be done without burning out a bearing, but it is a great risk to take, and even if a bearing is not melted, it is likely that the engine has suffered nevertheless. Probably the life of the bearings has been shortened or perhaps the cylinders and pistons have been glazed and scored enough to considerably hasten the need for reboring and new pistons.

Get into the habit of putting some oil into the engine every morning, even if it is only half a pint. By following this rule, the oil reservoir will never be very far from full.

A Page of Out-of-the-Ordinary Automobile Items

The Gypsy Trail for This Grocery-Store

A GROCERY-STORE that is motorized so that the market can be brought to your door has been devised by Clyde W. Martin, of Little Rock, Arkansas. The store is of the self-service type with a turnstile at one end and a central railing that divides the passageway between tiers of shelves on which the goods are stacked into two aisles. The chauffeur functions also as cashier, and the cost of clerk hire is limited to one man.

The cars do not generally cover a distance greater than eight or ten miles a day, so that there is just enough wear on the truck to keep it in good running order. The store has compartments for 122 varieties of merchandise. It is lighted by electricity and heated from the exhaust of the motor.

Twelve persons at a time, in single file, can shop in this store.

Benzine Motor Weighs but Seventy-Eight Pounds

PATENTED by Arvid Lind, of Sweden, this benzine motor weighs only seventy-eight pounds, develops six horsepower, and embodies novel features of design—there is only one cylinder, but two opposed

Weighing only 78 pounds this single cylindered motor develops six horsepower at 1500 r.p.m.

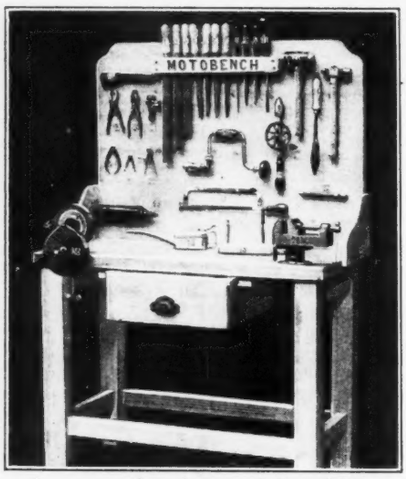
pistons are used. The cylinder is long, and divided in the center by a wall, and each half is fired alternatively so that power is being exerted on the crank-shaft almost continuously.

The motor is air cooled, and an aluminum hood running from a propeller fan attached to the shaft carries the air around the cylinder. The motor makes from fifteen hundred to sixteen hundred revolutions a minute under full load.

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

Collapsible Workbench Is Help in Home Garage

HAVING every tool within reach while the job is being done, and nothing to put away afterward, this bench is designed to occupy minimum space in the

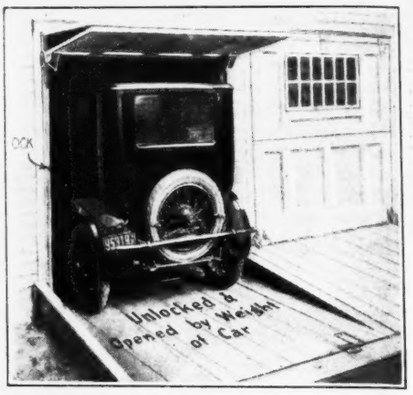


A compact bench containing thirty essential tools for the home garage

garage, and to be readily moved from one spot to another. All the tools fit into the drawer when the outfit is taken down.

Erected, the bench is three feet six inches long, four feet three inches to the top of the tool-board, and twenty-one inches wide. The tools illustrated are those shown by experience as the ones most needed in the repairs the automobile owner makes himself.

Unless a man is an expert mechanic, a job that cannot be performed with these thirty tools had better be sent to the repair-shop.



Garage Door Opened by Weight of Car

SHOWN above is a really automatic garage door. It is unlocked and opened by the weight of the car, and closes and locks itself by its own weight.

The car is stopped on the ramp leading to the door for ten seconds, which gives time for the ramp to sink and open the door by turning a chain-hoist actuated by a gear-wheel engaging with a rack on the forward end of the ramp. As soon as the car has entered the garage, the door slowly closes. A spring lock on the center holds the door tight. A person standing on the ramp does not furnish enough weight to operate this device; the car itself must pass over it.

TWENTY thousand car-owners were asked their opinion on the most important factor in the choice of a car. The list below tabulates their replies by percentages:

	Per Cent		Per Cent
Endurance	18	Flexibility	7
Comfort	11	Hill Climbing	6
Price	10	Endorsements	6
Appearance	9	Specifications	6
Economy	8	Speed	5½
Service	8	Appointments	5½

Amphibious Auto Cuts Water at High Speed

WHEELS that may be lifted above the water level in fifteen seconds by operating a lever are the distinctive feature of the amphibious automobile invented by Paul Panketan, of New York. The body follows the lines of a boat more closely than is the case with most European models. The engine is ninety horsepower.

The car can make ninety miles an hour on the road, and is handled and driven like the usual car. In the water a propeller gives a speed of thirty-four miles an hour.

The Home Workshop

New and Useful Things for the Practical Man to Make

Ornamental Storm Porch Simplified for the Home Worker

By A. Evans Elling

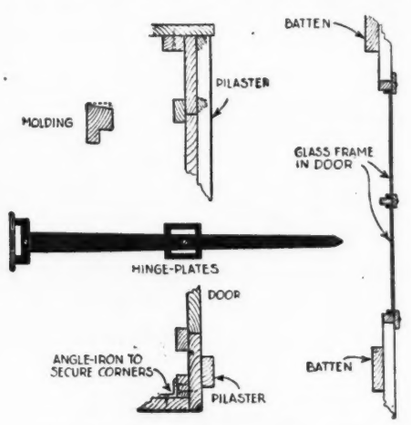
(Awarded First Prize in "Best Idea" Contest for January)

A STORM porch that will protect the front entry and living quarters from wintry blasts, at the same time reducing the ever-soaring coal-bills, may be constructed without difficulty in the home workshop. If the details are followed carefully, it will be found much more decorative in effect than the usual shedlike structure that serves as a storm porch and it is really easier to make. The removal of a few screws will permit its being taken down in sections and stored when the winter is over.

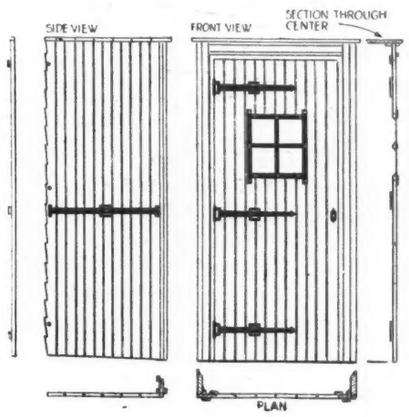
The tools required are a saw, a hammer, a screwdriver, a plane, a chisel, and a try-square. A brace and bits would be useful, but are not absolutely necessary.

The materials needed are 125 sq. ft. of ⅞ in. by 6 in. tongue and grooved ceiling, center beaded; 75 lin. ft. of 1 in. by 2 in. lath for battens to be used on sides and top and for corners and door-stops; a few pieces of ¼-in. hard wood to make the ornamental pieces in imitation of iron straps; a pair of 3-in. or 3½-in. butt hinges as narrow as can be bought, because the door is only ⅞ in. thick; sufficient 1½-in. No. 10 screws for all the battens; 2-in. screws to fasten sides to house; ¾-in. round-headed screws for the ¼-in. ornamental strips; small angle-irons and ¾-in. screws for sides, top, and floor; some 1-in. brads to tack on the ¼-in. stuff; 4 7 in. by 7 in. lights of glass; a screen-door catch or a regular rim-lock.

Make a batten door the same size as the house door, putting the battens as shown in the drawing. Use the ceiling for the battens, merely taking off the tongue and groove for neatness. Put at least two screws in each door piece to keep the door from sagging down when used, not less than 12 screws to each batten. Cut out the window opening 15½ in. high and 14½ in. wide. Nail on ½ in. by ⅞ in. strips for the top and bottom and fit and nail in place cross pieces of the same size to form the glass frame. The glass size should then be 7 in. by 7 in. The strips cut off the battens, bradded to the frame, will serve to keep in the glass.



Details of the hinge-plates, which are made of wood, the corner construction, and the glass frame



Elevations, plan, and sections of the storm porch, the dimensions of which may be varied to suit the builder

The storm entry is invaluable for exposed doorways and will serve equally well on the ordinary porch or veranda

The frame for the door is made of the same material as the door, the tongue and grooves being planed off. The 1 in. by 2 in. lath, going across the top and forming a stop for the door should hold the frame together if screwed on well. The lath will also serve for the pilasters, if it is smooth and clear; otherwise cut them from a good piece of ceiling. The two small moldings are made from the grooved edge of a piece of ceiling as shown in the detail.

The ends are readily made. They must be cut to the pitch of the porch floor and then fitted or "scribed" to the house and fastened on with the 2-in. screws. The top presents no difficulty. It is simply dropped on when made and attached with angle-irons on the inside.

The "butt" hinges are applied on the edge of door in the usual way. A good screen-door catch has served one porch for ten years. There is, however, a wide choice of locks for the purpose.

The ornamental "iron" plates, made out of smooth-faced wood ¼ in. thick, are not in one piece. The strips for the hinges are spear-shaped and those for the ends, straight. The other small pieces are cut out, as shown, with saw and chisel, and bradded on carefully. To get the desired effect before putting these on, they must be given two coats of standard dead black paint on all sides. After attaching, two more coats should be given to the face only. They will not then need touching up again for three or four winters.

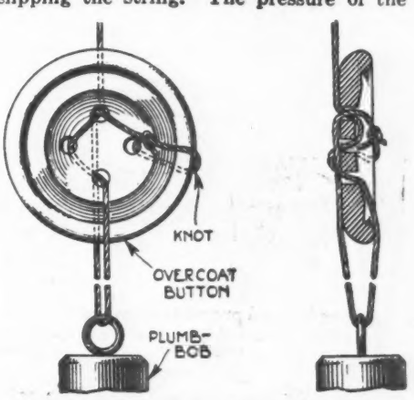
A good door-spring is advisable, also a strong chain on the inside to hold the door from banging wide open in strong winds.

This storm porch is intended to go on a regular covered porch, piazza, or veranda. If exposed to the weather at the top, the sides should be cut on a slight angle and the roof covered with painted duck or roofing.

Making the Plumb-Bob String Adjustable

THE illustration shows how a plumb-bob string is made adjustable by the use of an overcoat button. The manner of stringing the button is clearly shown in the picture.

The plumb-bob is lowered or raised by slipping the string. The pressure of the string on the loop underneath is sufficient to prevent the plumb-bob from sliding down by its own weight.—M. A. WISE.



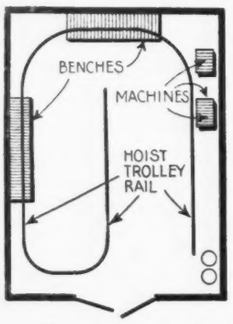
The weight of the plumb-bob creates sufficient tension to keep the cord from slipping

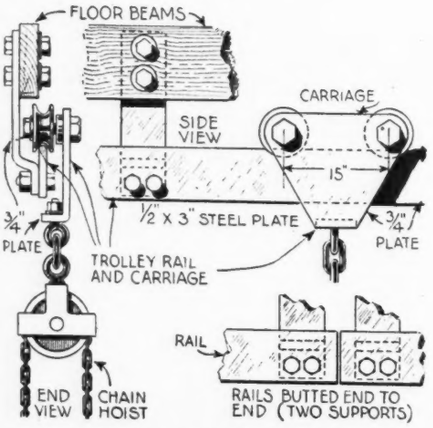
Make Your Garage 100 Per Cent Efficient

The winter months provide opportunity for installing improvements that will repay themselves many times over

Trolley-Hoist for Rapid Repairs

THE average method of locating a chain hoist in the repair-shop or garage is to secure a hook to a beam and fasten the hoist in one position, requiring the work to be brought to the hoist.





The plan at left shows arrangement of trolley to facilitate moving work around the shop. The details, illustrated at right, are simply constructed

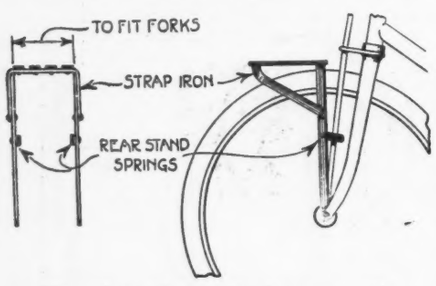
This method does not result in the most expeditious production of work, as wheeled trucks are required to take the motor, transmission, or other part away to clear the space around the hoist. By arranging a simple trolley or rail with a carriage to support the hoist and extending this trolley about the circumference of the shop, the hoist is available for practically any job in any location. A ½-in. by 3-in. plate strip with offset brackets about 3 ft. apart can be placed to extend around the sides through the center of the shop and over the benches, making it convenient to remove a motor or part and place it rapidly on the workbench.

The carriage consists of two flanged rollers secured to a hanging bracket of plate. The supports are readily made up of bent plate and can be secured to the upper floor beams.—G. A. LUERS.

Provide Your Side Car with a Wheel Stand

WHEN motorcycles with side-car attachments are not in actual use and are kept in a garage, the tire of the side-car wheel sometimes rests on a floor covered with grease and oil. This has a highly deleterious effect on the rubber of the tire.

The writer provided his side car with a stand attachment clamped on the axle as shown in the illustration, and found it useful to protect the tire of the wheel from



Hinged stand prevents damage to the tire standing for long intervals on an oily floor

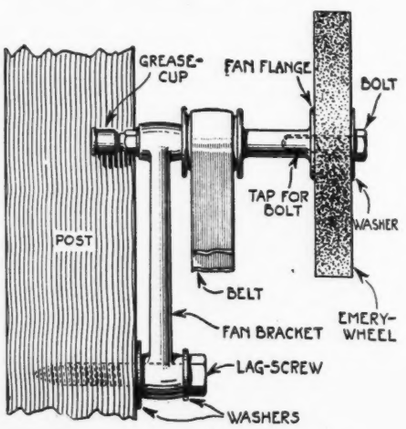
contact with the grease-covered floor or to jack up a wheel on the road if it was necessary to make a repair.

The brace or stand is hinged and when not needed is swung out of the way against the axle and held in that position by a spring catch.—R. K. TAYLOR.

You Can Convert a Fan-Bracket into an Emery-Wheel

A LITTLE grinding outfit for the workbench or the garage can be made out of a Ford fan-bracket and an extra bolt and some washers.

Remove the fan-blades from the flange at the end of the shaft by placing the



Method of converting a Ford fan-bracket into a small grinder

shaft of the fan in a vise so that the flange rests as close as possible to the vise jaws. Then the rivet heads can be knocked off with a cold chisel and hammer.

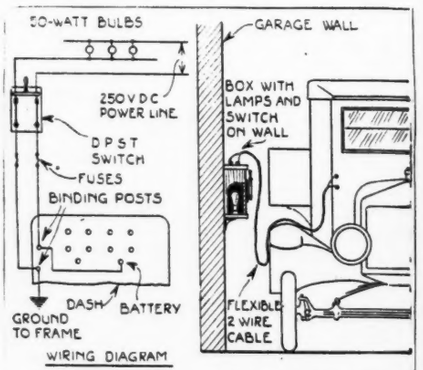
Tap the shaft 1 in. deep and as large as practical for a bolt, which should be a trifle shorter than the combined thickness of the emery-wheel and the depth of the hole. This will allow the wheel to be drawn up to the flange as tightly as desired without the end of the bolt touching the bottom of the hole. A washer on the bolt acts as a second flange.

A good way to mount the grinder is on the side of a solid post. A lag-screw with two washers will hold it solidly in position. It should incline at an angle so that the grease-cup will clear the side of the post. Belt to the engine or motor and take up the tension by adjusting the angle with the lag-screw.—L. B. ROBBINS.

Cold-Weather Battery-Starting Stations for Fords

UNDISPUTED is the fact that a Ford (without a self starter) is more easily started in cold weather by the use of dry-cell batteries or other low-voltage cells than by the use of the magneto, but this trouble disappears once the car is warmed up.

My Middle Western firm had a fleet of Fords. A starting box or battery, like that



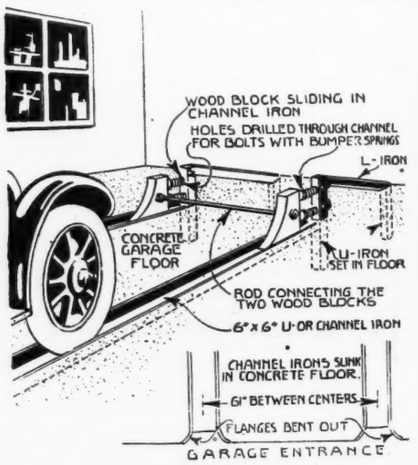
The installation of this starting-box will save time getting Fords under way

shown in the illustration, was rigged up in the central garage.

After the engine has been started from the battery, switch over to the magneto, pull the cable from the binding-posts, after having thrown out the punch-circuit switch, and the car is ready for service.

Automobile Track and Bumper for the Garage

IF building a garage for one or more cars the owner will do well to construct the floor with tracks, spaced correctly and made of 6-in. channel iron. Slit the ends, bend them out and bring them to grade


WOOD BLOCK SLIDING IN CHANNEL IRON
HOLES DRILLED THROUGH CHANNEL FOR BOLTS WITH BUMPER SPRINGS
L-IRON
CONCRETE GARAGE FLOOR
U-IRON SET IN FLOOR
ROD CONNECTING THE TWO WOOD BLOCKS
6" x 6" U-OR CHANNEL IRON
CHANNEL IRONS SUNK IN CONCRETE FLOOR.
61" BETWEEN CENTERS
FLANGES BENT OUT
GARAGE ENTRANCE

The tracks guide the car and the bumpers stop it gently

level. The wheels will track in nicely and come to rest almost imperceptibly.

The wooden bumper blocks are held in position by separator iron rods and are faced with corrugated rubber matting.

Celluloid as a Substitute for

ging it into the shop on the floor by means

Is Your Speedster Ready-

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A Radio Receiving Outfit, no matter how costly is no better than it's 'phones. When buying your Receiving Outfit buy BRANDES' 'PHONES with it. They guarantee maximum loudness since their perfect construction allows them to make the most of long distant signals. Brandes are sold on ten days' trial. Get them at your dealer or send direct.

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No. 56, with improved headband, 2000 ohm set $5.00; 3000 ohm set, $6.00. Recommended and sold by all radio dealers. Free trial and absolute satisfaction guaranteed.
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Latest type. Ready to operate (except antenna) $65. Set only $35. Built by America's pioneer manufacturers.
Clapp-Eastham Co.
Cambridge, Mass.

Celluloid as a Substitute for the Automobile Lens

THE writer was once caught in a storm with his car and a collision with a tree broke one of the lenses in the lights. The pouring rain was bound to cause a short circuit in the electric system and to prevent

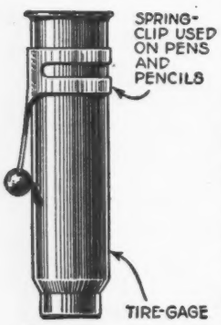
In an emergency, lens may be made from celluloid

this a substitute lens was made from a piece of celluloid which happened to be in the repair-kit.

The old lens was used as a guide to cut out the celluloid with a sharp jack-knife. This celluloid prevented the inflow of rain and allowed a reasonable amount of light to pass.—J. B. MORAN.

Spring Clip Prevents Loss of the Tire Gage

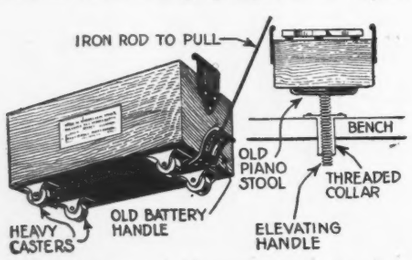
EXTREMELY simple is this method of carrying the tire gage to prevent its loss among the tools. Place a small spring clip, such as is used on pens and pencils, about the body of the gage. Catch this on the edge of any projecting ledge under the engine hood or at the edge of the door pocket. If properly returned each time after it has been used, the gage will readily be found and another source of annoyance will be ended.



Protect your tire-gage from loss as you do a fountain pen

Battery-Charging Station Will Welcome These Aids

A TRUCK sufficiently large to hold a storage battery is illustrated here. It is used to haul the batteries from the automobiles to the charging department. While



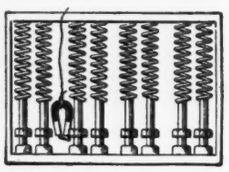
In charging-stations this truck and painting-stand will be found useful

this is a very simple arrangement, consisting of four large casters on a board having an old battery handle at each end, it nevertheless saves a great deal of lifting and is far better for the battery than dragging it into the shop on the floor by means of the usual "end-gate rod." Furthermore, it lessens the possibility of dropping the battery when one of the handles on the battery has become loosened.

The other convenience illustrated is a revolving and elevating bench-stand used in painting the overhauled battery before it leaves the shop. The battery can be placed on this stand and turned so that all sides and even part of the bottom can be given a good coat of paint. While this particular one was made of the screw part of an old piano-stool, it may be made of pipe-fittings; but of course the height could not then be varied.

Recovering Lost Valve-Keys

Magnet makes it easy to draw up missing pieces with wire



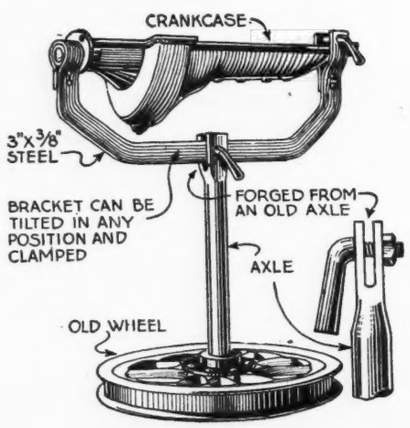
VALVE-KEYS sometimes slip down behind the valve or in a crowded corner and are difficult to reach with pliers or fingers because of the limited space.

A small magnet with a wire attached will bring forth the lost key, as shown in the accompanying illustration.—J. C. OTTOFY.

Shopmade Stand for Ford Crankcase Repair

A STAND to facilitate the handling of Ford crankcases while doing such repairs as welding frame arms, brazing on the forward end or universal-joint end, and brazing the oil drain-cup, is made as shown in the illustration.

It consists of a Ford front wheel forming a base, into the hub of which a vertical bar is set. The upper end of the bar is provided with a clamp for holding a bracket



This adjustable stand will facilitate the repair of Ford crankcases

to clamp the opposite ends of the crankcase. One end of this bracket has an old drive-shaft coupling riveted on it, with bolt-holes for securing the end of the crankcase. This coupling is free to turn in the riveted bracket end. The opposite end of the bracket is fitted with a clamp coupling to secure the round bearing on the front end of the crankcase.

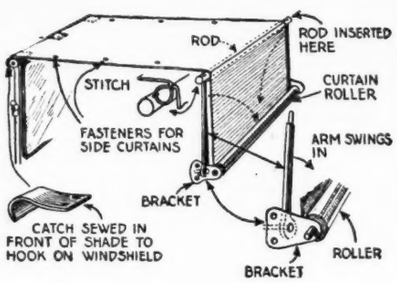
When the crankcase is set into the stand, it is adjustable to any position, can be tilted, turned over, or arranged in the most desirable position for working.

Is Your Speedster Ready for a Rainy Day?

WHEN the car is exposed to the rain a covering or top for the speedster is necessary. A simple and inexpensive cover is shown in the illustration. It can be raised or lowered rapidly. When lowered, the top is housed in a narrow space behind the seat, or between the gas-tank and seats.

The top consists of a length of waterproof canvas, seamed at the edges and mounted on a sturdy curtain-roller. The catch-pawls are removed from the end of the roller to keep the top stretched tightly. Two swinging arms are arranged to fold down over the rolled curtain and these are held down by means of hooks, which are used to hold the top against the windshield. One single rod through the curtain is supported by the swinging braces.

Side curtains can be provided with this arrangement, though these are a refinement that can be added later if found necessary. To add side curtains, eyelets are placed at the edges of the top and fas-



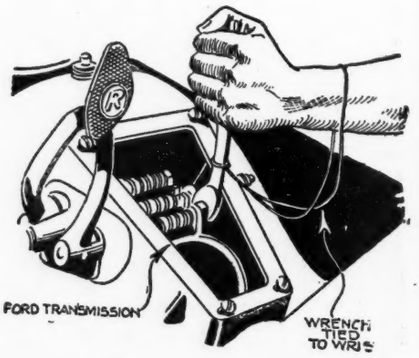
A waterproof top for your speedster will make its winter use very much more enjoyable

tens into the side parts. The top should be built low, about 6 or 8 in. above the heads of the passengers. The absence of top bows allows this small clearance inasmuch as a jolt can do no harm to the occupants.

Tie Wrench to Your Wrist as a Precaution

IN adjusting the transmission bands of a Ford, great care has to be taken that the open-end wrench does not slip from the hand and drop inside, out of reach.

To avoid this, tie a strong cord or twine securely about the end of the wrench, and, leaving 7 or 8 in. of cord, tie the other end of cord loosely about the wrist. Should the wrench slip from the hand, it can be recovered instantly.

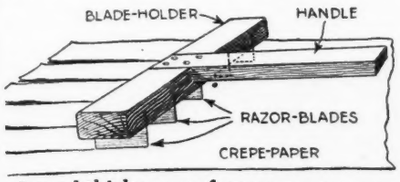


A simple little loop of string may save you the annoyance of having to fish your wrench out of the transmission

THE HOME WORKSHOP

Another Use for Old Safety Razor Blades

HERE is another use for old safety-razor blades which the writer found practical. It is a device for cutting strips of crape-paper for decoration purposes. The blades were mounted in a piece of wood that had

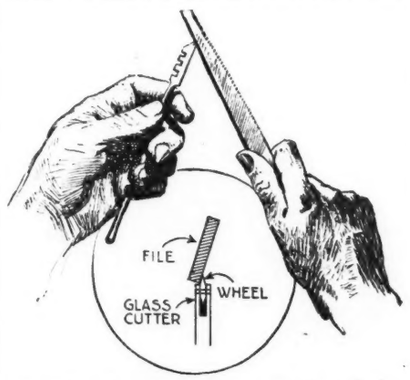


Several thicknesses of crape-paper may be cut at one time

saw-cuts into which the blades were forced. The piece holding the blades was provided with a handle. It is necessary only to draw this device lightly over the crape-paper to cut it into strips.—CARL ROYER.

Dull Glass-Cutter Given New Edge with File

FEW things are more annoying than to have a piece of window-glass to cut and nothing to cut it with except a dull old cutter. If there is no hardware store near



In filing the cutter, care must be taken to preserve the original angle

by from which to obtain a new cutter, try sharpening the old one with a file.

Hold the cutter in the left hand and carefully draw the file across the bevel of the wheel a few times. See that the wheel turns with the file at each stroke, so that the edge will be freshened up all the way around. If the sharpening is properly done, the cutter will once more be of service.

To Carry Your Dividers in the Pocket with Safety

A PROBLEM that young draftsmen constantly meet is how to carry their instruments without the bulky case.

Corks protect the points

Insert the divider points, slightly spread, into a cork, swing the holder at other end back to the legs as much as possible, to reduce the length of the instrument and you can carry the dividers in your pocket without being pricked by the points.—A. E. ZIPPRICH.

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The war on film

Dental science has declared a war on film. That is the cause of most tooth troubles. And brushing methods of the past did not effectively combat it.

Film is that viscous coat you feel. It clings to teeth, enters crevices and stays. Then night and day it may do serious damage.

Film absorbs stains, making the teeth look dingy. It is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Very few people have escaped the troubles caused by film.

Two film combatants

Now two combatants have been found. Many careful tests have proved their efficiency.

A new-day tooth paste has been created, and these two film combatants are embodied in it. The paste is called Pepsodent.

Now every time you brush your teeth you can fight those film-coats in these effective ways.

Also starch and acids

Another tooth enemy is starch. It also clings to teeth, and in fermenting it forms acids.

To fight it Nature puts a starch digestant in saliva. She also puts alkalis there to neutralize the acids.

Pepsodent multiplies the salivary flow. It multiplies the starch digestant in the saliva. It multiplies the alkalis. Thus these teeth protecting forces, twice a day, are much increased.

They must be done

These things must be done. Teeth with film or starch or acids are not white or clean or safe. You know yourself, no doubt, that old tooth-brushing methods are inadequate.

See what the new way does.

Make this pleasant ten-day test and watch your teeth improve.

A few days will tell

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear.

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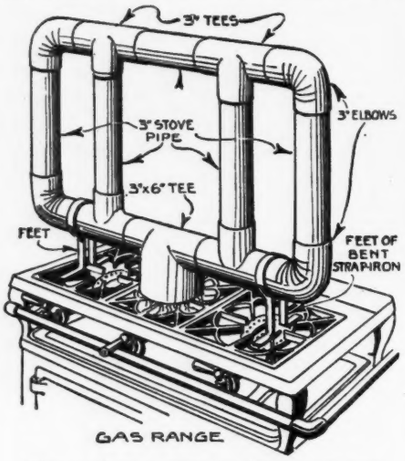
THE HOME WORKSHOP

Gas-Stove Radiator Made of Stove-Pipes

VERY efficient is this detachable radiator made of stove-pipe of 3-in. diameter. Four straight pieces are used in an upright position and they are held together by the fittings, as shown in the illustration. The T in the center of the base is 6 in. by 3 in. The 6-in. opening fits over the gas-burner and receives and distributes the heat. About 25 ft. of radiation is obtained and only a small flame is needed to keep a room



The radiator may be hung up out of the way when not in use

sufficiently warm in moderate weather or frost resisting in severe spells.

To make it stand firm, a piece of wire is twisted around each end of the lower horizontal section and the ends are permitted to flare out and rest on the stove-top, thus serving for legs or standards.

Electric Lamp Made from an Old Stool

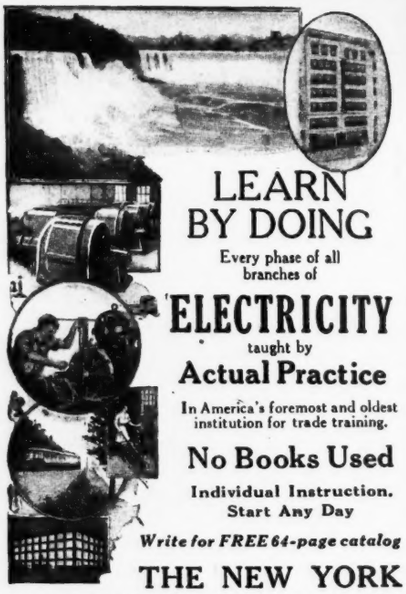
AN electric lamp for your den may be made from an old stool. Select the best leg of the stool for the upright post. Cut off a piece about 6 in. long, with allowance of ¾ in. to fit into the base; drill a 5/16-in. hole through the entire length of the post, insert a 1½-in. piece of ⅛-in. gas-pipe into the top, to which the chain-pull socket is screwed.

Select a piece of hard wood for the base, 6 in. in diameter and ¾ in. in thickness. This can be shaped to suit the maker. Drill a hole of the same diameter as that of the post that is to be inserted into the base. Insert the post and glue it fast. When dry, drill a ¼-in. hole through the base to the center of the post for the wires and in the end of this hole place a ¼-in. screw rubber washer, which helps to give an excellent finishing touch.

Boudoir lamp may be made from an old piano-stool

Glue a piece of felt on the bottom of the base to prevent scratching your table. Sandpaper and finish in mahogany or oak.

The shade can be made from a few pieces of wire covered with silk or some other material.—H. E. MENDE.



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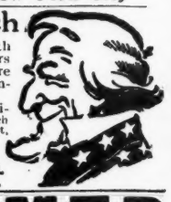

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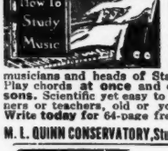

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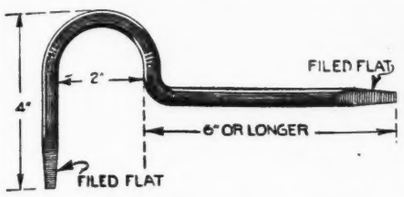
THE HOME WORKSHOP

Powerful Screwdriver for Use in Close Quarters

THE merits of a screwdriver made along the lines of the one shown in the illustration are many. The principal feature, however, is the immense leverage that can be exerted when using the shorter arm on the screw and the longer one to turn the screw.

The tool shown here is made of octagonal steel. The blades may be ¼ in. or less,



Powerful leverage may be exerted with this double-end screwdriver

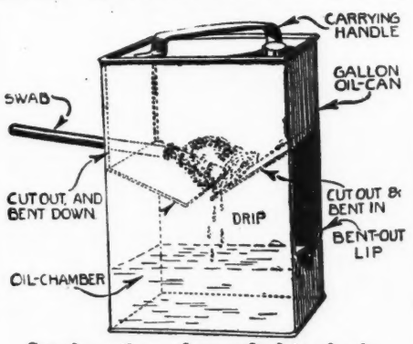
or the full width of the metal, whichever is best suited to do the work required.

Where screws are inaccessible with the ordinary driver, as under projecting parts, the short end of this tool is quite indispensable, to remove or tighten screws. In using the long end on a screw, the curved part will be found to offer an excellent grip for the hand.

Should it be used by electricians, the whole tool, except the black points, can be insulated with rubber tape or tubing.

A Combined Oil Container and Swab Tray

TO increase the likelihood that surfaces that need it will receive an application of oil in good time, it is advisable to make a combined oil and swab tray such as is shown here. It is made of a square-cornered tin gallon can, preferably one having a carrying handle at the top. Opposite faces of the can are cut and bent as indicated, approximately the central third of one side and the upper third of the other. The full width of the side is cut close to the

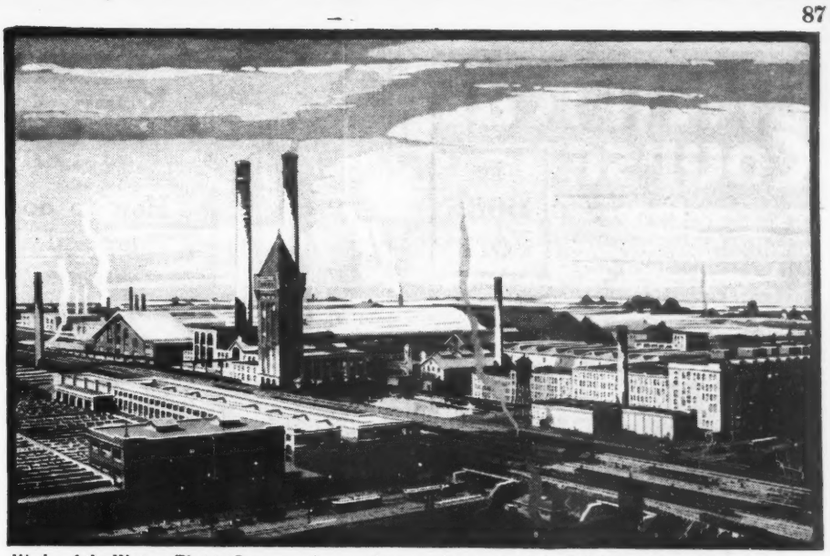


Surplus oil on the swab drips back into the reservoir at the bottom of the can

corners—an old pocket-knife proving an excellent tool for this purpose.

Part of the ends of the bent-in portions may have to be cut off before breaking them in to form the swab shelf. The rim of the oil chamber is bent outward slightly in order to provide ample entry for the swab. Any excess of oil that may be left on the swab after use drains back into the oil-chamber when the tray is set away.

It is self-evident that this combination is always ready and is easy to carry—which is half the battle won for steady use.



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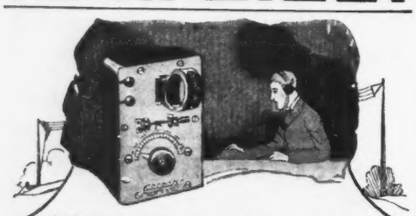

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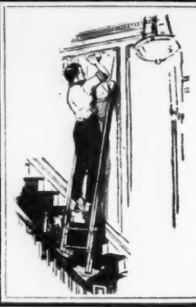

Keeping the Home Shipshape

How to do those odd jobs around the house that save time, temper, and money

Mending Leaks

WITH the best of care water-pipes will sometimes freeze and burst in extremely cold weather. At such a time the plumbers are so busy that it may be necessary to mend the pipe temporarily with whatever means are at hand.

As soon as the leak is discovered—and that probably will be after the water system has been thawed out—shut off the water in the cellar and let the water drain from the house pipes by opening the faucets. Thoroughly dry the pipe at the point where the break has occurred and if the edges are at all rough, smooth them by tapping them gently with a hammer.

Cut a piece of thin, tough wrapping paper at least ½ in. larger all around than the hole to be patched and shellac it on one side, at the same time coating the pipe with shellac. Apply the patch to the pipe and put on another thin coat of shellac. While this is drying, which will take only a few minutes, tear a piece of old cloth into strips about 2 in. wide. Then give the pipe another coat of shellac and immediately wrap it with the strips for a distance of at least 2 in. each side of the break. Let each turn of the "bandage" overlap the preceding, and fasten the end with shellac or adhesive tape. This joint will be perfectly waterproof and will last for some time.

If shellac is not available, melted candlegrease may be used as a substitute, but the pipe will have to be warmed before an attempt is made to mend the break.

Renovating Floors

THE first step in renovating a *varnished* floor when it has become badly worn is to scrub it thoroughly with a brush and water, using a good scouring powder. Do not be too liberal with the water; a wooden floor should never be flooded. After the surface is entirely dry, flow on a thin coat of varnish, which will have to be left to dry for some time, depending on the kind of varnish. If, therefore, the room cannot be dispensed with even temporarily, it is advisable to use in place of the varnish a wax finish. Do not use shellac over the old varnish.

A floor that has been *shellacked* is apt to be white in places where water has been spilled upon it. Rub the spots with a soft cloth moistened slightly with alcohol and they will disappear or be greatly improved. Do not continue rubbing too long, or the shellac will be taken off right down to the bare wood. If the floor is in such bad shape, it needs to be refinished; remove the shellac with a vigorous application of wood alcohol and bleach it with oxalic acid. It is as bad to use varnish over old shellac as the reverse.

The appearance of *waxed* floors is improved by dusting them frequently with canton flannel, which may be wrapped around a broom. In places where the finish is worn, rub a thin coat of wax well into the wood and let it dry for an hour before polishing. If complete refinishing is required, wipe the floor well with turpentine as a preliminary to applying the wax.

Protecting Pipes

IF you have any water-pipes in the house that are not well protected against freezing, this is the time to cover them. It is much easier to guard against the pipes freezing than to thaw them out and patch them up afterward.

Any non-conductor like bagging, straw, or oakum will serve as a wrapping, but if the pipes are badly exposed to very severe weather, it is better to take further precautions. First, cover them with a thin layer of straw, sawdust, tan-bark, or the like, and then pack around them pieces of unslaked lime about the size of a potato. Wrap another layer of the insulating material around them and bind the whole firmly together with old bagging or cloth of some kind.

The purpose of the first layer is to protect the pipes from the action of the lime and the outer covering allows so little air to reach the lime that it will continue to generate heat all winter.

Chair Upholstery

DO not be afraid to undertake the re-upholstering of a chair or sofa, if you are willing to devote a little time and pains to the work. First of all, carefully remove the old covering and notice how the professional upholsterer did the work in the first instance.

Cut the material for the seat the right size, smooth it in place, and drive a few tacks on each side to hold it. Then begin in the middle of the front and drive ⅜-in. tacks about 1 in. apart, working toward the corners and turning under the edge of the material to keep it from raveling. Neatly fold the material under at the corners and proceed to do the sides and back.

Stretch the upholstery as tightly as possible, keep it smooth and wrinkleless and see that the design, if the material is figured, lies square with the front edge of the chair. When you have accomplished this to your satisfaction, tack gimp over the edges. Use either very small tacks, "staggering" them so that both edges of the gimp will be well secured, or brass-headed tacks, which must be placed in a straight line except on certain chairs of Heppelwhite design having a sort of festoon decoration worked out in tacks.

To drive a tack in a difficult corner where you are afraid of damaging the chair frame, press it into place with the fingers and drive it home with the aid of a nail-set or a long nail, the head of which should be placed against the head of the tack.

Can We Live One Hundred Years?

(Concluded from page 31)

is of machines that are of man's invention.

In any weak spot in our bodies disease germs may find congenial soil for their growth, and from it they may exert their activity. Much as light focused on one point will burn into material, such disease centers are "focuses of infection." Doctors call the disease process "focal infection."

Such focal points are most likely to be developed among those who have become susceptible to disease by reason of unhealthful surroundings or unwholesome living, dissipation, exhaustion, undue exposure, previous long and debilitating illness, mental strain, improper or insufficient food, or injuries. They often shorten our existence when there is no real reason why they should. From some infection focus the germs of some grave disease will travel in the lymph and blood channels to various organs and tissues, until serious illness manifests itself.

That is why all of us should visit the doctor, as we do (or ought to) the dentist, for a thorough overhauling at least once a year. Only thus can there be timely detection of infection granaries in the system.

Doctors have found that the following are the great danger spots in our bodies, the points where diseases and poisons are bred that shorten our lives: Decayed teeth and gums, diseased tonsils, adenoids, noses and throats affected with catarrh, middle-ear disease, the gall bladder, and the appendix.

You have not learned the lessons of recent medical progress if you do not realize that unsuspected infections at some such points as these may be responsible for almost anything wrong with you, from an utterly run-down state to outright disease. An annual physical overhauling is the one means most likely to uncover these hidden infection centers before disease develops.

Your Expectation of Life

THE average length of the human life is now about fifty years, according to Dr. A. J. Barker Savage, superintendent of the Broad Street Hospital, New York. At the close of the eighteenth century it was about thirty years, and in the days of Queen Elizabeth only about nineteen years!

Despite these strides in longevity already taken by the race, only four persons out of a hundred reach the age of sixty-five, and only three out of a thousand live to be ninety-five. We are still a long way from the hundred mark!

If you pass sixty-five years, your expectations of life will be as follows:

AGE	PROBABLE LIFE IN YEARS	AGE	PROBABLE LIFE IN YEARS
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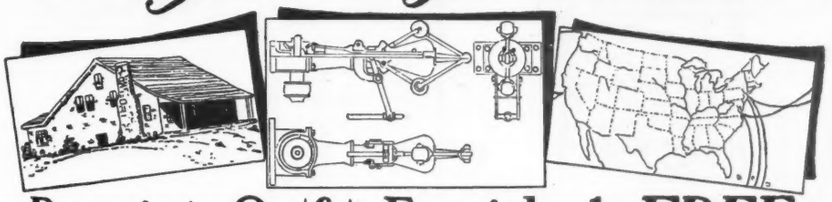

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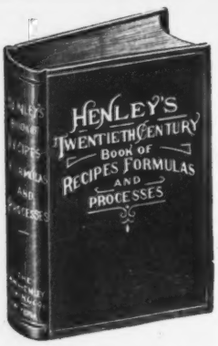

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The Home Workshop Department Will Award First and Second Prizes Totaling $50 for the Best New Ideas in February and March

A FIRST prize of $35 and a second prize of $15 will be awarded to the authors of the two best articles appearing in the Home Workshop Department next month. Every article will be considered as a possible prize-winning contribution. Those which do not win prizes may be purchased at space rates. The prizes wi l be awarded upon publication and checks will be mailed to the winners during the month.

Prize-winning articles may be long—but not over 1000 words—or they may be very short. The idea, device, or machine described must be practical and ingenious; it must fill an actual need in the home, office, or shop.

The contest must not be confused with other contests in this issue. The last "Best Idea" awards will be announced in the March issue.

Prize-Winners for January

The two prizes of $50 and $25 for the "Best Ideas" appearing in the January issue of POPULAR SCIENCE MONTHLY have been awarded respectively to **A. E. Elling,** of Nutley, N. J., and **Robert M. Johnson,** of Baltimore. These two ideas were considered by the judges to possess the highest all-around merit of those submitted.

Homemade Sprayer Serves as Air Brush

By Robert M. Johnson

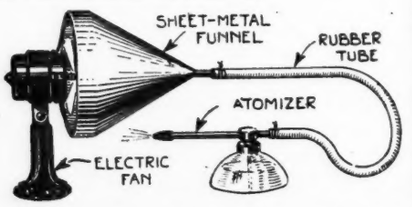
(Awarded Second Prize in the "Best Idea" Contest for January)

USUALLY the job of shellacking or varnishing is troublesome to the amateur mechanic. He scrapes and sandpapers his woodwork to a glasslike finish, only to have the shellac pile up in unsightly ridges and the varnish collect hairs innumerable.

No matter how easy it is for the professional painter to manipulate a brush, the man in the home workshop would much prefer to use an air brush if he had one. Lacking one, he can make a sprayer that will operate without an air compressor by rigging up a funnel of sheet metal to fit snugly over the guard of an electric fan and connecting the outlet with an old atomizer by means of a rubber tube. The weight of the funnel will be sufficient to prevent it from blowing loose.

The blast of air from the fan will blow a delicate and easily controlled spray of shellac or varnish against the article to be finished in exactly the same way that an artist coats a charcoal drawing.

The only precaution necessary is to see that the liquid is not too thick. The device has worked so well that I am making another reservoir that will not have to be filled so frequently as the small atomizer bottle.



The breeze from the fan, concentrated by the funnel, takes the place of compressed air in this homemade sprayer

[The general utility of Mr. Johnson's idea is not dependent entirely upon the use of an electric fan. A hand or foot pump would provide a more powerful spray and do the work as well, if not as conveniently.—*The Editor.*]

What the Home Workshop Will Do for YOU Next Month

THE biggest step forward in real service to readers ever taken by the Home Workshop department will be announced next month, when POPULAR SCIENCE MONTHLY's new plan to furnish blueprints is launched.

In brief, the one most interesting and useful article described in each issue will be completely illustrated with working drawings, to be supplied to readers at a nominal cost.

Among other February features are:

Complete plans for making a child's realistic and roomy playhouse from wallboard.

How to hook up an audion detector and amplifier; an ornamental humidor, a home workshop filing-cabinet for clippings and shop sketches; decoy minnows for ice fishing; a homemade electric heater and heating-pad; and other articles to interest every member of the family.

"Bench Talks" on how to get better results and more pleasure from your home workshop.

Watch for the new blueprint service!

THE HOME WORKSHOP

How to Fit and Fasten Your Storm-Sash

AS a preliminary to fitting storm-sash, provide yourself with two thin strips of wood as measuring-rods. Cut one the correct height to fit neatly in the window opening, not too tight, and cut the other to give the width. Lay these on the storm-sash and if the sash is too large, plane it off. Bevel the bottom to suit the sill.

If the window is within reach of the ground, three 2-in. screws each side of the sash will keep it in place, and if the screws are oiled before being used, they will come out easily when necessary. When it is out of reach from the ground, four short hooks and eyes placed on the inside will suffice. But it takes two to handle the sash—one to hold it in place and the other to attach the

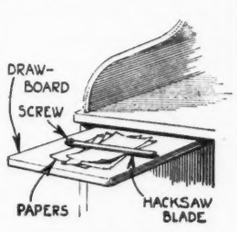
Storm-sash fastened in this way are easily put up and taken down

hooks. Although this is sometimes done, it is not a plan to be recommended.

There is a better plan. Cut off two tenpenny wire nails 1½ in. from the pointed end. Bore two holes in top of sash, as shown in the drawing, just 1 in. deep, no more; the drill must be at least one size less than the nail-dowel. Now drive the iron dowels in, blunt end down. This leaves the pointed end sticking up ½ in. From inside the window, slip out the storm-sash, jab it up in place, and then bring it back into the room. You will see plainly in the head of the window two marks made by the points of the dowels. Drill holes at these points a little larger than the thickness of the nail-dowel and not less than ½ in. deep. Lay down the sash and screw in two hooks, one near each side about 2 in. up from the bottom on the inside of the sash. Two eyes are put in the sill so that when the sash is hooked up, it will be perfectly secure and easy to put up and take down each year.

Old Hacksaw Blade Used for Paper-Clip

DO not let your papers lie scattered around when it is possible to make a clip for holding them together on the drawleaf of your bench or desk. An old hacksaw blade is placed across the board. A small screw through the hole in one end of the blade will hold it securely.



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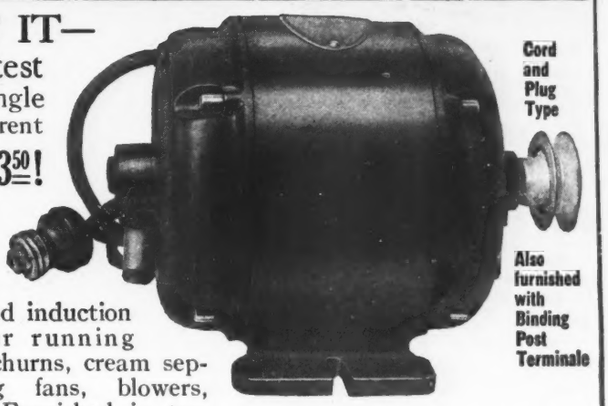

This is lower than the before-war price. Motor is 110 volt, 1740 rpm, 60 cycle, split-phase, fan-cooled induction type. Suitable for running washing machines, churns, cream separators, ventilating fans, blowers, lathes, drills, etc. Furnished in two styles—with cord and plug as illustrated; or with binding post terminal (reversible type).

Motor weighs 24 lbs. bare, 33 lbs. boxed It is the latest type of a large, responsible manufacturer, who guarantees every motor shipped, for one year, and attaches to each a **guarantee service tag,** serially numbered which entitles owners to a new motor, by express prepaid, should defects develop within a year. Repair parts are always available at low cost; but motor is so sturdy and has so few parts that repair expense is negligible. Price complete, boxed, f.o.b. Chicago

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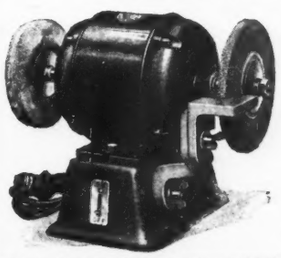

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31 x 4	10.60	16.90	35 x 4½	14.95	24.45
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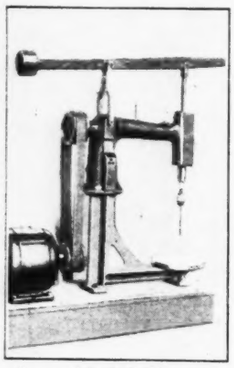
THE HOME WORKSHOP

Old Sewing-Machine Becomes Drill-Press

By Frank Boosman

THE accompanying illustrations show how, with the aid of two castings, I converted part of an old sewing-machine into a very serviceable drill-press, operated by a ¼-hp. motor.

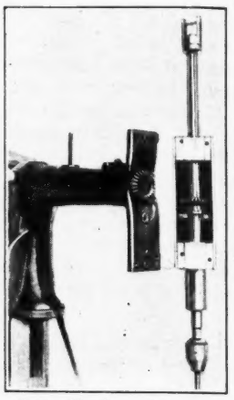


Assembled drill-press connected with ¼-hp. motor

The machine and the motor were fastened to a wooden base, which made them portable.

Patterns were made for the bracket or base casting that supports the drill-table and also for the miter gear housing, which was provided with a Babbitt-metal bearing for the drill-spindle.

The spindle was made of a piece of ½ in. cold-rolled steel shafting, having a ⅛-in. keyway for the set screw shown in the miter gear. The top end has a forked swivel that receives the hand lever. The other end has a steel sleeve shrunk on. This takes the shank of the chuck. The chuck has a drill capacity of 0 to ¼ in. The hand lever is weighted to hold up the drill.



Spindle housing removed to show gearing

A hard-wood pulley takes the place of the old balance hand wheel on the horizontal shaft that passes through the sewing-machine head. The other end has a miter gear that replaces the cam that operated the needle-bar and presser-foot of the old machine.

New Prize Contest
"How I Made Money with My Tools"

HAVE you ever made extra money with your tools? If you have, we want to know just how you did the trick. If you constructed something, describe it. If there is a particular job that you do, let us know what it is. For instance, we have heard of a chap who mends furniture in his neighborhood during his spare time. Others have established spare-time businesses with tools as their only investment.

Sit down now and describe your own experience for the readers of POPULAR SCIENCE MONTHLY. If you have photographs or drawings of the things you have made or the job you do, send them along.

Tell your story as humanly and interestingly as possible.

$90 in Prizes

POPULAR SCIENCE MONTHLY intends to make this worth your time. If you do not win one of the three big prizes it is possible that your article will be bought at space rates. First Prize will be $50; Second Prize, $25; and Third Prize $15.

Conditions of the Contest

(1) Contestants are not limited in the number of ideas. The contest is open to everybody.

(2) If a drawing is sent in, it need not be made by a skilled draftsman. The contestant's name and address should appear on each sheet of drawings.

(3) Drawings and photographs must be accompanied by a description, preferably typewritten, in which the subject is clearly explained. The MSS. must be written on one side of the paper only, and should not be more than 500 words in length.

(4) Drawings and descriptions entered by contestants must be received by POPULAR SCIENCE MONTHLY not later than 5 p. m., on January 20, 1922.

(5) The judges of the contest will be the editors of POPULAR SCIENCE MONTHLY.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best idea.

The second prize of $25 will be paid to the contestant who submits an idea next in merit.

The third prize of $15 will be paid to the contestant who submits an idea third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of POPULAR SCIENCE MONTHLY, and their articles will appear later.

(8) The editors of POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(10) Send drawings and specifications to the Editor of the Making Money with Tools Contest, Popular Science Monthly, 225 West 39th Street, New York City.

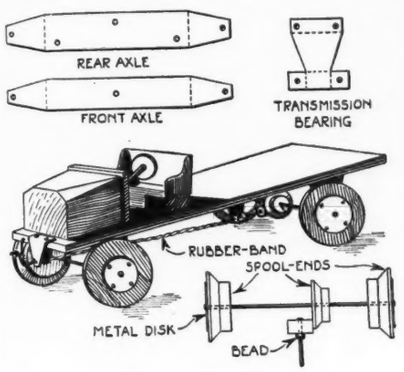
THE HOME WORKSHOP

Nursery Motor-Trucks Can Be Made at Home

WHAT more delightful toy can be imagined than a motor-truck that will run forward or backward under its own power and can be cranked like a regular car.

The chassis is a piece of wood 2 in. by 10⅜ in. The front and rear ends are tin and the wheels are made from linen-thread spools, the holes of which are plugged. The axles are simply soft wire 1/16 in. in diameter, with the ends flattened to prevent the wheels from turning.

The method of providing power is clearly indicated in the drawing. The rubber band,



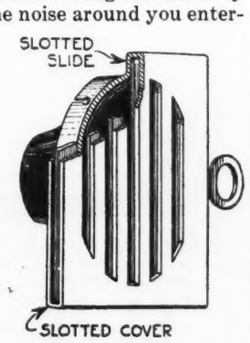
Turning the crank of this toy truck twists the rubber band that provides the power for driving it

which can be twisted by the wire "crank," is connected with the friction drive by a primitive universal joint. The addition of a properly shaped block of wood to represent the motor hood, together with a steering-wheel and seat, give the toy a semblance of reality that can be heightened by the judicious use of paint.

To operate, hold the drive wheel and turn the crank to the right until the elastic is tight. Then hook the crank so that it cannot revolve. Winding the rubber to the left will drive the truck backward.

How to Keep Noises Out of the Telephone

THE illustration shows a little device that will enable you to telephone from a boiler factory without being disturbed by the noise. It is the noise around you entering the transmitter and being sent back into your own receiver that disturbs you.



This transmitter cover muffles near-by noises

The device has a grated or slotted face, with a slotted slide inside, and it will slip over any phone mouthpiece. The slotted slide has a handle projecting at one side. By pushing the handle in, the openings in the slide and the face of the device come in line with each other and you may talk into the phone. When you can't hear what the other party is saying, pull the little handle out and the slots are closed, and in this way the noises are muffled.

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3 HANES ELASTIC CUFFS are made far stronger and better than the usual cuff. They fit the wrist firmly, they won't flare or rip from the sleeve.

4 HANES CLOSED CROTCH is cut and stitched a special way that really keeps it closed.

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Each Hanes garment has to pass inspection by experts before it reaches you. That's why you can rely on Hanes buttons to stay on; the reinforced buttonholes to keep their shape; the non-irritating seams to hold fast.

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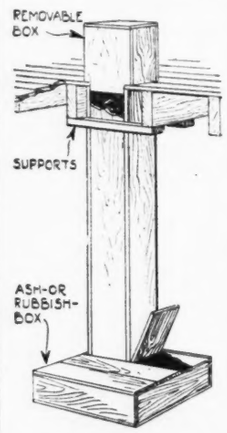
THE HOME WORKSHOP

Dust and Paper Chute Will Save Many Steps

MANY steps up and down the cellar stairs may be saved by the installation of a chute for dust and paper. The location of the chute should be chosen carefully by the home worker before he makes plans for constructing it. Probably the best place will be in a corner of the kitchen or in the rear of the hall. The top was arranged in this instance to keep the children of the household from tumbling into the chute, but a plain cover like a small trapdoor could be substituted. It should be made so as to close flush with the floor. When sweeping is being done, the cover is removed and the dust swept directly into the chute, obviating the use of a dustpan.



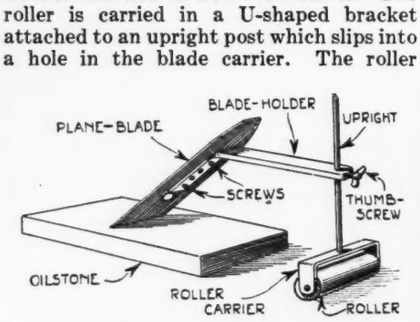
Sweepings fall through chute to cellar

The same general plan could be used for the disposal of ashes from the kitchen stove, only the chute should then be lined with sheet metal to avoid any danger of fire.—E. E. MOORE.

Sharpen Your Plane-Blades with This Jig

WHEN the home worker endeavors to sharpen his plane-blade, he often finds some difficulty in producing a good angle on the cutting-edge. In the motion of rubbing the blade back and forth on the oilstone, it is hard to hold the blade constantly at the same degree of inclination.

The illustration shows a jig for holding the plane-blade. It consists of a bracket for holding the iron at the proper angle and a roller that acts as a sort of a caster. The roller is carried in a U-shaped bracket attached to an upright post which slips into a hole in the blade carrier. The roller



The angle of plane-blade remains constant while being sharpened

should be preferably of iron, although not necessarily; a section of an old curtain-pole will answer, provided it is accurately drilled. The blade-holder should be flattened at one end so as to provide a firm bearing surface for the plane iron, and a series of holes should be drilled to accommodate blades of different lengths. A thumbscrew is used to bind the blade-holder to the upright post at the proper height.

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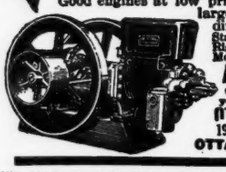

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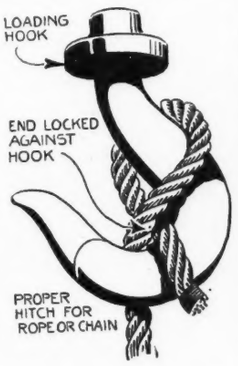
THE HOME WORKSHOP

Hitching a Rope Securely to a Hook

THE picture illustrates the proper method of fastening a rope around a crane-hook. It is very simple if only you follow directions.

Place the rope over the hook in the manner shown and the hitch will always be safe, for the greater the strain of the load, the tighter will be the hitch.

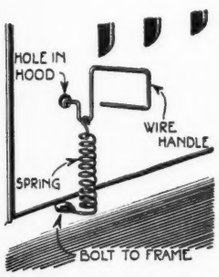
This is a sailor's old trick, and it can be absolutely relied upon.—J. H. MOORE.



The heavier the load, the tighter the rope

Try This Clip for the Hood of Your Car

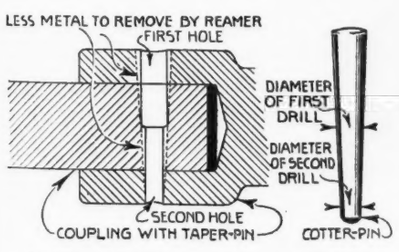
SOMETIMES the clip for holding the hood on an automobile is broken or lost. One may be made easily, as shown in the drawing. The handle and hook are of heavy wire. The hook hooks through a small hole in the hood or to a clip fastened to the hood. The spring may be bolted to the car-frame outside the hood.—R. E. DEERING.



Hooked spring holds hood closed

Easy Method of Reaming Tapered Cotter-Pins

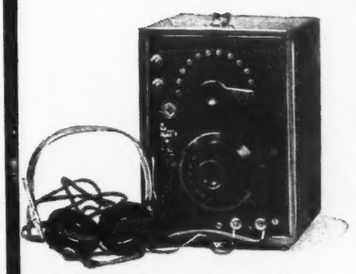
EXCESSIVE wear and premature destruction of the reamers used to cut holes for tapered cotter-pins may be avoided by the simple expedient of drilling two holes of different diameters at the position for the cotter-pin as shown in the illustration. This applies to any collar, gear, or part to be secured to a shaft with a taper-pin.



Drilling two holes as shown simplifies reaming for a tapered cotter-pin

By starting with a drill the size of the center of the tapered pin and finishing with a drill the size of the small end of the pin—drilling with each halfway through the part—nearly all the metal is removed. The reamer will readily cut the remainder. This is easier on the drills because the first drill provides clearance for the second.

THE WORLD'S NEWS BY WIRELESS IN YOUR OWN HOME



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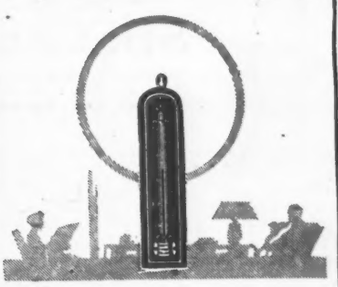

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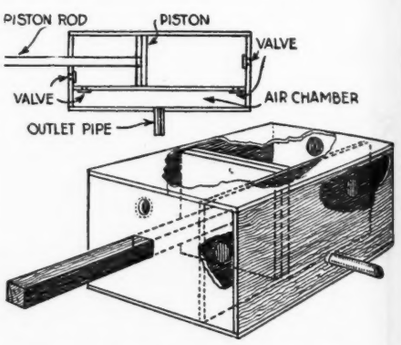
THE HOME WORKSHOP

"Chinese Bellows" for Forge Made Entirely of Wood

IF blacksmithing work has to be done and the forge bellows will not operate properly or no blower at all is at hand, it is possible to make what is known as "Chinese bellows." A saw, steel square, and hammer will be tools enough, although a plane can be used to advantage.

The device, which is really not a bellows at all, but a simple air-compressor, consists of a square box 10 or 12 in. wide and 2½ or 3 ft. long, in which a wooden piston-head, operated by a wooden rod, fits closely.

On one side of this box is fastened a narrow compartment in the center of which is an opening for the air pipe leading to the forge. Inside each end of the main box is an ordinary flap valve, and near each end are two more valves, opening into the narrow compartment. These valves may be



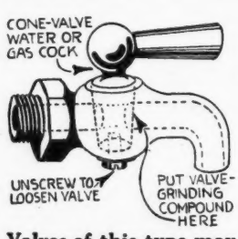
Plan of the blower showing piston, valves, and air chamber, and method of assembling

made of old belting or cut from the leg of a discarded boot. Tacking small blocks of wood to them will make them fit better when closed. The back-and-forth motion of the piston operates the bellows.

With a crank, drive wheel, and belt attached to the piston-rod, it will work fast enough to give an almost steady current of air to the forge even with a piston stroke of only an inch or two. The piston may be made to fit more snugly by making it of two pieces of board, nailed together with a piece of old blanket, projecting slightly all around, between them. The grain of the two pieces should be at right angles.—ADRIAN V. HOFFMAN.

Repair for Leaky Faucets and Air-Cocks

MOST air-cocks and water-faucets that work on the principle of a revolving cone inside a box or housing leak after they have been used a while because they are not properly seated. To remedy this, grind them as you would the valves on a motor or gas-engine.



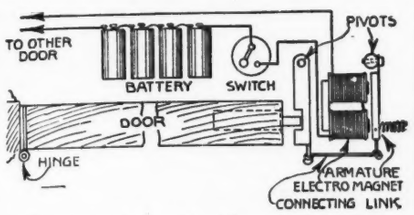
Valves of this type may easily be reground

Take out the cone and put some coarse valve-grinding compound on it, replace the cone and turn it. Then remove it and wash it with gasoline. Repeat the operation with a fine compound.

THE HOME WORKSHOP

An Electric Door Interlock for Two Doors

WHEN a bathroom has two doors that open to different rooms, considerable annoyance is often caused by some one leaving one door locked and going out by the other door. The simple electric lock shown in the accompanying illustration



Construction and wiring of a simple electric interlock for a bathroom with two doors, both being locked simultaneously

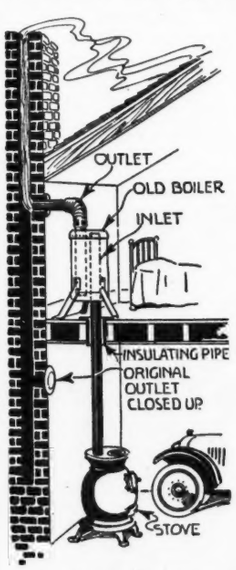
overcomes this objectionable feature and also eliminates the necessity of locking each door separately.

The lock stop is replaced by a hinged piece, which in turn is actuated by a pair of battery-energized electromagnets. When in the bathroom, the switch or pushbutton switch is closed; the armature forces the stop over. This prevents either door from being opened.

With this scheme the doors cannot be locked from the outside and one door cannot be locked or opened without the other.—V. H. TODD.

Rigging Up a Heater for the Second Floor

SHOWN in the illustration is an economical method for heating the second floor of a building, with only one stove and utilizing the heat that normally passes out through the chimney. The stove-piping is put through a hole in the ceiling and the floor above. The pipe is led into a boiler, drum, or other similar tight sheet-metal casing. This pipe is led to a position near the top. A second pipe leading to the chimney flue on the second floor, is let into the top of the drum and brought to a position near the bottom.



Heat from the stove circulates in a drum on the second floor

The normal draft of the chimney causes circulation in the drum and the heated gases coming in contact with the drum keep this at a temperature sufficient to warm the room. Apart from the inconvenience of maintaining a stove on a second floor, this heater is safer, provided a flue-pipe is placed around the pipe where it passes through the floor and the drum is supported by steel or iron braces to keep from contact with wood.—G. A. LUERS.

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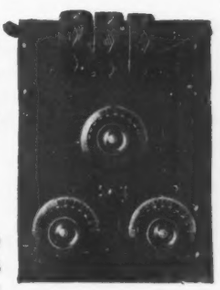

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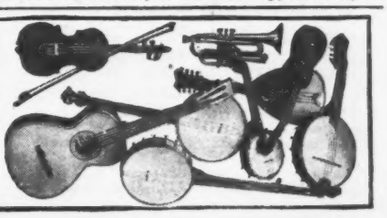

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THE HOME WORKSHOP

It Converts a Pump Cylinder into a Builders' Level

A BUILDERS' level sufficiently accurate for much ordinary work may be constructed at small cost from easily obtainable materials. The level proper is made from a foot-pump cylinder threaded at both ends to take brass caps. These hold two plain glasses against paper washers at each end of the tube. The glasses have intersecting cross lines drawn on them with the most careful accuracy.

On top of the tube a hand spirit level is clamped with brass strips so that it is perfectly parallel with the horizontal axis of the instrument. The whole device, with its base of wood and iron, is mounted by means of a ⅜-in. standard swivel-bolt and wing-nut to the top of a standard adjustable camera tripod.

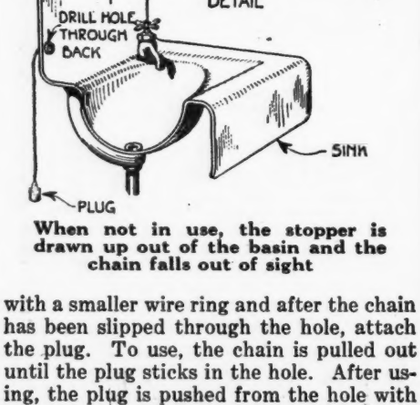
Details of home-made level and method of use

When the instrument is in use, the legs are adjusted so that the level swings true at all degrees through which it may be turned. The readings will be as accurate as ordinary purposes require up to a distance of about 100 ft.—P. P. AVERY.

Keeping the Stopper Chain Out of Sight

THE chain attached to a sink stopper is always in the way and it is usually a problem what to do with it. Try the suggestion below, which could be used on almost any bathroom basin.

Remove the chain terminal and the large ring on the stopper. Fasten the stopper with a smaller wire ring and after the chain has been slipped through the hole, attach the plug. To use, the chain is pulled out until the plug sticks in the hole. After using, the plug is pushed from the hole with one finger and its weight (which should be a little more than that of the chain and stopper together) pulls the stopper out of the way.—DONALD W. CLARK.



When not in use, the stopper is drawn up out of the basin and the chain falls out of sight

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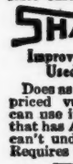

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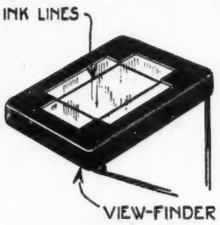
THE HOME WORKSHOP

Lines on Finder Will Help Your Photography

THE amateur photographer is oftentimes baffled by the seeming inability to center his subject in the view-finder. At the time of exposing, it seems that the subject is all within view, and then, when the pictures are developed, it is found that some part of the picture is cut off.

To prevent this, draw with a straight edge four translucent or opaque lines across the glass of the view-finder, as shown in the drawing. To prevent the spread of ink on the glass, touch it with a rag moistened with soap and water and then quickly wipe dry.

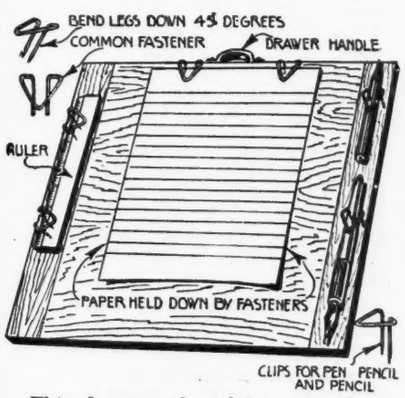


Good pictures are easier to take with this view-finder

If the lines are placed as shown, one can see at a glance just what portions of the total view shown in the finder will appear in the print, whether the camera is held lying flat or on end. As soon as one becomes more expert and can ascertain this spacing automatically, the lines can be wiped off.—DALE R. VAN HORN.

Paper-Clip Holders Will Improve Portable Sketching-Board

A SMALL drawing-board used for field work or for sketches in the home workshop may be improved by the addition of paper- and pencil-holding devices made from ordinary paper-clips. With a file, sharpen the points of brass clips of the shape illustrated until they can be driven easily into the wood. Thrust two in the top edge near the working face of the board and bend them forward so that they will



This drawing-board is a complete unit and may be carried around easily

act as springs to hold the paper firmly in place. Two more are utilized at one side of the board to hold a small metal rule. On the opposite side two additional clips are driven in vertically after being spread out as shown. These will hold the pencils or a pencil and penholder.

A drawer pull may then be screwed to the top edge to serve both for carrying the board and hanging it up. With such a board you can be sure of always having writing and drawing material ready at hand in a neat, convenient, and portable shape.—JENNIE E. MCCOY.

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THE HOME WORKSHOP

Try This Handy Roller for Heavy Loads

BY using the roller shown in the illustration, one person can move a stove, trunk, barrel, or a heavy box. Lift one end of the load, slip the roller under, and the article to be moved is easily handled.

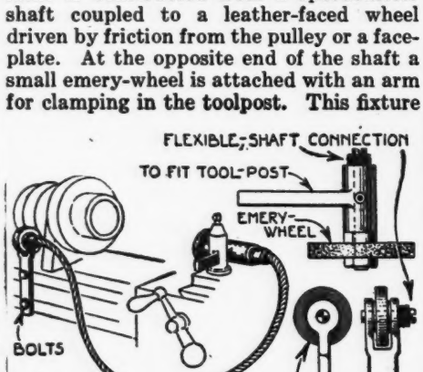
The materials required are: 2 pieces of 2-in. scantling 4 in. wide and 18 in. long, 2

When a hand truck is not obtainable, a homemade roller constructed as shown will handle heavy loads

iron bolts (with nuts) 13½ in. long and 1 in. in diameter, wooden roller 10 in. long and 4 in. in diameter with an iron bar 13¼ in. long and ½ in. in diameter for axle. The picture clearly shows the construction of the device, requiring no explanation.

Unique Flexible Grinding Fixture for the Lathe

A USEFUL device for doing either internal or external grinding with a lathe is constructed from a speedometer shaft coupled to a leather-faced wheel driven by friction from the pulley or a faceplate. At the opposite end of the shaft a small emery-wheel is attached with an arm for clamping in the toolpost. This fixture



This friction-drive grinding attachment for the lathe will take the place of an expensive electric grinder

can be applied to either a foot- or power-driven lathe and takes the place of a motor for clamping in the toolpost, and it has the advantage of flexibility that permits it to be used in any position to which the toolpost is turned.

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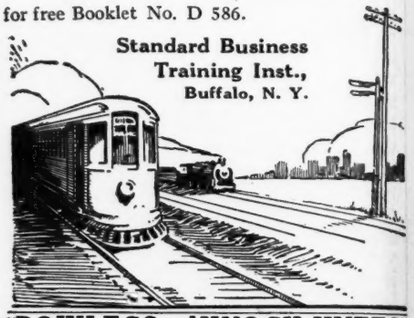

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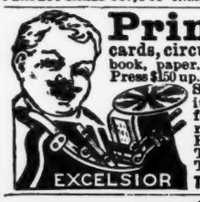

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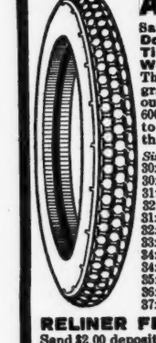

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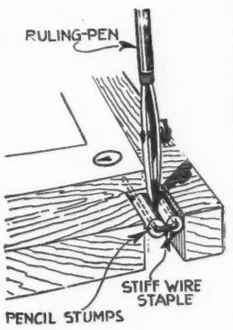
THE HOME WORKSHOP

Keep the Ruling-Pen from Being Clogged with Ink

RULING-PENS easily become clogged at the point and the ink stops flowing, more especially while drawing fine lines, or when the pen is not used for a few minutes. The ink can be started by drawing the pen across the finger sideways or over a piece of paper, but this is not a very good practice.

The ink-flow can also be started by pressing the two points of the pen together, but this, too, soils the fingers.

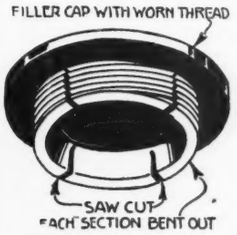


Squeezing pen-nibs together makes ink flow

Cut a square in one corner of the drawing-board from one of the warp grooves already cut. Make a stiff wire staple and drive in two small cylinders cut from a used lead-pencil. The pen can be pressed lightly down in them quite conveniently and the ink-flow started. This is a very handy homemade attachment for the home draftsman.—F. W. BENTLEY, JR.

It Is Possible to Renew Worn Threads of Filler-Caps

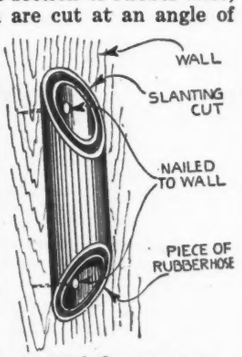
FILLER-CAPS for tanks, air-washers on tractors, and the like, on which the threads have become worn, may be renewed for further service by taking a hack-saw and slotting the thread ring in several places and then forcing the various sections outward a slight distance—enough to cause the threads to again engage firmly.—LOUIS SCHNEIDER.



Hacksaw cuts permit threads to be sprung out

Door-Bumper Improvised from Rubber Hose

WHEN appearances are not important, a serviceable door-bumper may be made from a short section of rubber hose, the ends of which are cut at an angle of about 45 degrees. This is placed in a position to serve as a buffer where the knob, pull, or door edge strikes the wall. It is fastened by a nail near each end. The purpose of the slanting cuts is to remove a sufficient amount of rubber to permit the nails to be driven home.



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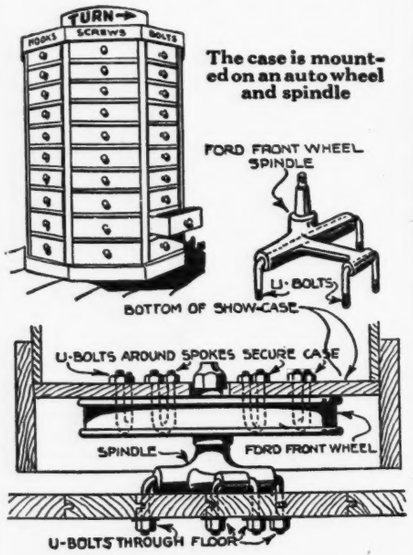
THE HOME WORKSHOP

Revolving Tool and Stock Case Takes up Little Room

WHEN it is desired to place a revolving tool-case in the shop, the mounting shown in the illustration may be made from odds and ends in the repair-shop junk-pile.

The pedestal consists of a front-wheel spindle, similar to that used on a Ford, bolted down to the floor with U-bolts, to make it rigid. The front wheel is mounted in place on the spindle and the case is mounted on this, being secured by U-bolts



The case is mounted on an auto wheel and spindle

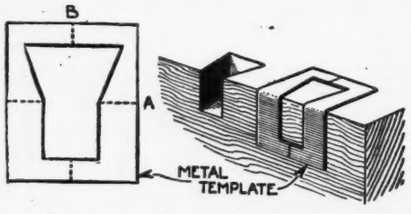
about the spokes of the wheel. This mounting is substantial and free-running, due to the ball or roller bearings in the hub of the wheel. A small quantity of grease in the hub will last indefinitely.

The chief advantage of this type of case with several compartments is the economy in space, which is important in a small shop or store. The fixture can be set up close to any corner.

Dovetails Easily Laid Out with Brass Template

HANDY dovetail templates or markers may be cut from odd bits of brass or other metal, as shown.

I make use of a number of those accessories, in varying sizes, of course. In the cutouts, both the face and end of each



Pattern for dovetail template and method of using the device

dovetail is represented, the center lines being marked on the metal beforehand. Each one is then bent over.

Thus, when any number of dovetails are to be cut, the template is pushed along the edge of the wood until the center mark is reached. The necessary markings can then be quickly and accurately made on the wood.—GEORGE H. HOLDEN.

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THE HOME WORKSHOP

This Road Signal Cannot Easily Be Tipped Over

LIGHTED lanterns used as danger signals are often placed in an insecure manner. In work along highways, for instance, a lantern may be lighted and left standing seemingly secure within a wooden frame enclosure, or left slightly embedded on the top of a pile of gravel; then during the night the weather will change and a

Lanterns used as danger signals on road work are more dependable if embedded in solid concrete bases

good stiff gust of wind will blow the lantern over.

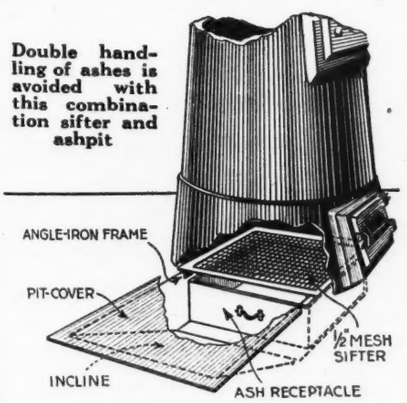
To prevent such accidents, the California State Highway Association is using non-tipping lanterns formed by permanently embedding them at their base in pyramidal, concrete blocks 12 to 15 in. square on their base, and having finger cavities on all four sides of the base for lifting purposes. The lanterns are easily and quickly fitted with these bases by using a wooden form for holding the concrete till it has hardened.

Sifter beneath Furnace Separates Cinders from Ashes

A CONVENIENT time- and labor-saving device for separating cinders from ashes is illustrated in the picture.

A pit about 16 in. deep is dug under the furnace, extending as shown by the dotted lines. A wire screen of ½-in. mesh stretched over an angle-iron frame is placed over the top of the pit, directly under the furnace grate. The ashes and unconsumed coal fall from the grate to the

Double handling of ashes is avoided with this combination sifter and ashpit



top of the mesh sifter. The ashes and cinders can then be moved forward and backward on the mesh sifter until all the ashes fall through into the metal receptacle placed in the ashpit; the cinders remain on the sifter.

The ashes may be removed from the pit by pulling the ash receptacle to the end of the pit and sliding it out. The ashpit outside of the furnace should be covered.

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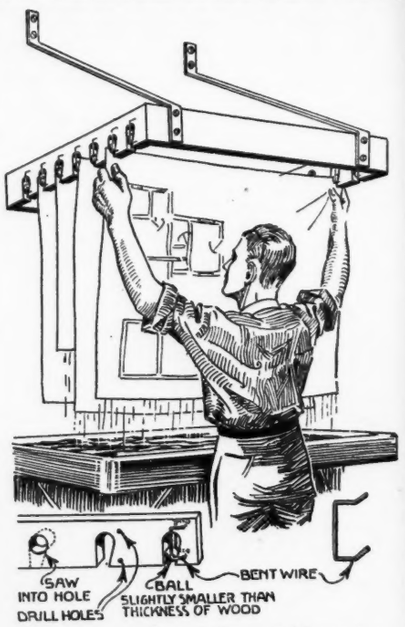
THE HOME WORKSHOP

Drying Blueprints on a Homemade Rack

THE illustration shows a rack for drying blueprints that will soon pay for itself in the saving of time and ease of operation.

The prints are inserted in the slot, between the ball and the side of slot. As the



The upper edge of the wet blueprint is slipped into the slots, where it is automatically held

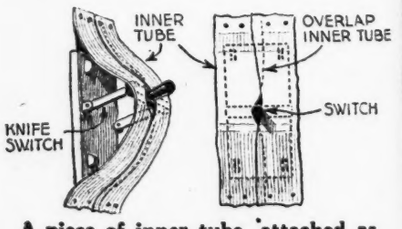
slots are wider at the top than at the bottom, the prints will readily enter, and cannot drop out, as the weight of the ball on the taper side of the slot acts like a wedge against the prints, without preventing their removal by hand.

If the prints are of different sizes, as many rows of fasteners can be used as are necessary.—H. C. ROBINSON.

Inner Tube Used to Cover a Dangerous Switch

SOME knife switches are so placed as to be dangerous when handled, especially if on a high-voltage system. By using pieces of an old inner tube, sufficient protection can be procured to make the addition worth while.

Cut two strips nearly twice as long as the switch and about two thirds as wide. Tack



A piece of inner tube, attached as shown, protects one from accidentally touching the blades of the knife switch by accident

the ends to the wall at each end as shown, and be particular to lap the inside edges so the switch handle will always be hugged by the two pieces of rubber, no matter in what position it may be. Then when the switch is thrown in or out, the strips will prevent the hands from coming in contact with the bare metal and thereby receiving a shock.—L. B. ROBBINS.

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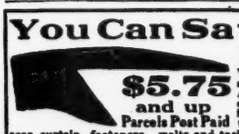

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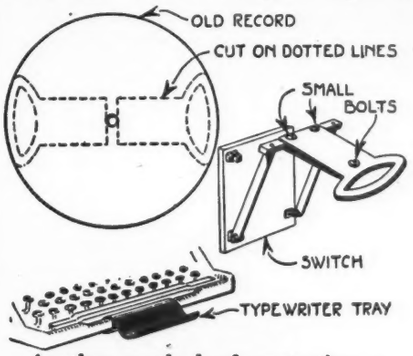
THE HOME WORKSHOP

Old Phonograph Records Have Many Uses

OLD phonograph records may be adapted for many uses in the home workshop, especially in electrical work. Suppose it is desired to provide an ordinary knife-switch with a safety handle that will preclude any possibility of a shock, even if the switch is thrown on by a person with wet hands. On a record place a pair of



Another method of protecting a knife-switch is here shown, as well as a useful typewriter tray

handles shaped as shown in the illustration, cut them out, drill the necessary holes, and bolt or rivet them on the switch handle.

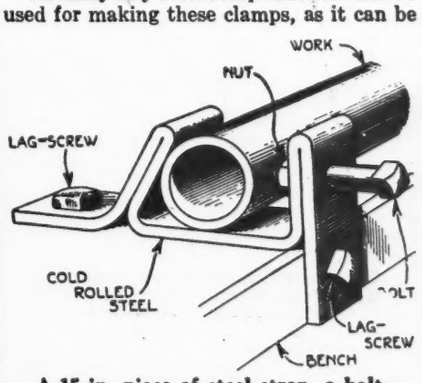
By warming a rectangular piece from a record over a flame and shaping it around a broomhandle, a neat and convenient tray can be made to be attached to the front frame of a typewriter. It will be just the thing for holding eraser, eraser guard, and pencil.

An old record is said to be superior to sandpaper for pointing a pencil. In an emergency thumbtacks and pushpins may be made by dipping the heads of tacks into a dish in which fragments of a record have been melted, and the same composition may also be used for sealing jars, bottles, and batteries.—JOHN NEUERBURG.

Simple Bench-Clamps for Bar Stock or Pipe

BENCH-CLAMPS can be made without requiring more than a bolt and nut and a drill to drill out the holes used for securing the clamps to the bench.

Virtually any steel-strap material can be used for making these clamps, as it can be



A 15-in. piece of steel strap, a bolt, and two lag-screws make this pipe clamp for the bench

cold bent to the desired shape. These clamps serve to hold bar stock or pipes while cutting, bending, straightening, or cutting pipe-threads. Use a piece of wrought iron or steel, about 15 in. long, for each clamp. Make the double bend shown and bolt to the edge of the bench.

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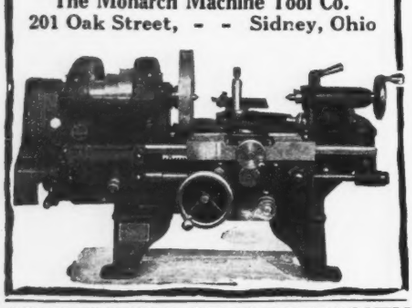

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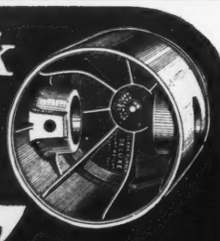

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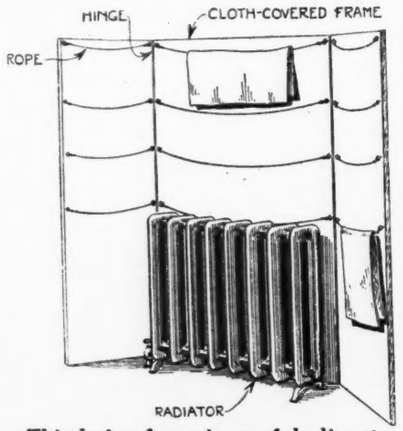
THE HOME WORKSHOP

Wet Clothes Are Quickly Dried on Frame Over Radiator

IN many an apartment where there is no coal-range in the kitchen and the entire suite is steam-heated, it is sometimes a difficult problem to dry clothes in an emergency when dampness prevents the use of the usual outdoor line. With a framework such as is illustrated here, any



This drying-frame is a useful adjunct to the laundry in bad weather and will fold up when not in use

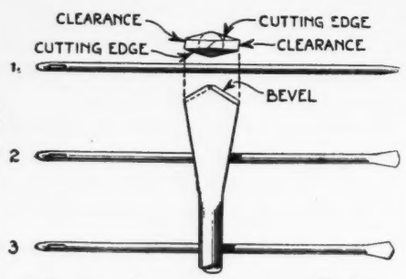
radiator may be transformed temporarily into a steam-drier.

Construct the drier of three frames made of narrow strips of wood and hinged together. Ropes are attached for hanging the clothes and the whole is covered with white cotton. When in use the drier is opened so as to surround the radiator on three sides; when not in use, it may be folded up and stored away in a closet or behind a door.

Use Sewing-Needles for Drills in an Emergency

WHEN a small drill for metal is required and a regular drill is not at hand, the home mechanic can make one with very little difficulty from an ordinary sewing-needle. The only trick is in grinding the point.

The first step is to heat the end of the needle and flatten it to the illustrated



The steps in converting a needle into a drill and an enlarged detail of the point are here illustrated

shape. Then grind it carefully to a point, following the drawing exactly and taking care to provide the necessary clearance. By heating the end again and plunging it in water, it can be retempered. To hold the drill-point in an ordinary breast drill it will be necessary to push the "eye" end into a piece of soft wood small enough to enter the jaws of the drill. When the jaws are tightened, the wood will be compressed sufficiently so as to grip the drill-point tightly.—P. A. BAUMEISTER.

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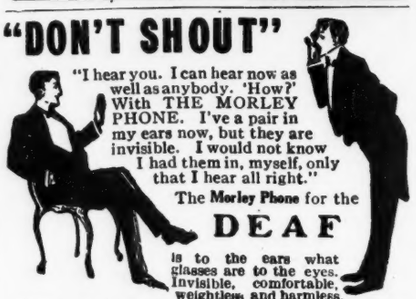

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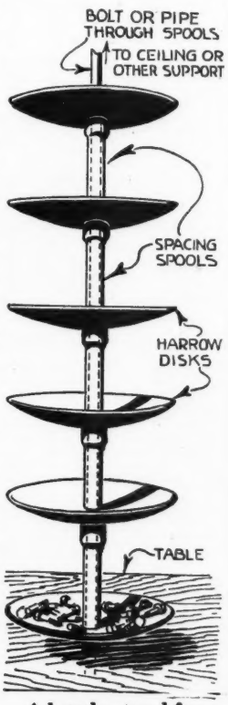
THE HOME WORKSHOP

Rotating Disk-Blades Form a Useful Tray-Stack

OLD farm disk-harrows, such as a search of almost any junk-yard will disclose, may be used as stacks of trays merely by setting them up on end, convex sides down. It will be well to remove the bearing members and replace them with the regular smooth spacing spools. It is also practicable to use a longer rod or bolt than the one that is used to assemble the disks in the harrow. A higher stack of trays is thus made possible.



A handy stand for bolts, nuts, and small parts

This is one of the handiest tray assemblies that can be used on the farm, in the shop, or in a factory, for bolts and parts of various sizes and kinds can be kept separate in them and yet in close relation.

A mounting should be provided at top and bottom, so that the whole stack may be freely rotated, giving full access to every part of the trays.—LOUIS SCHNEIDER.

Waterproof Envelope Made from Old Inner Tube

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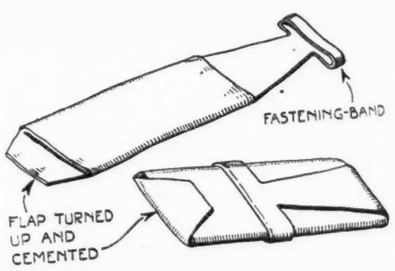
A good waterproof envelope may be made from a section of inner tube. Cut a



Method of cutting, cementing, and folding a portion of an old inner tube to make a waterproof envelope

piece after the pattern shown in the illustration and fasten the lower end of the envelope with rubber cement. The envelope is closed by folding and passing the rubber band on the upper end over the lower end.

The envelope also will prove serviceable for campers, automobile tourists, hunters, trappers, and any one who expects to be exposed to rain or a particularly damp atmosphere.—R. E. DEERING.

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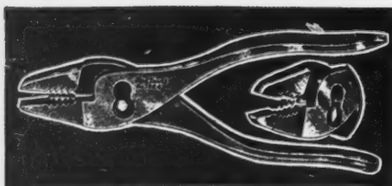

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Put up in bags in assorted sizes from 3/16" to ⅝" in the following quantities: 30 in a bag, 15c; 50 in a bag, 20c; 90 in a bag, 25c. Also put up in an assortment of 530 washers in nine of the most practical sizes, in a handy tin box. Send for circular. ***From dealers or from us.***

Mechanics' tool booklet free.

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"Red Devil" Glass Cutters—the glaziers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown here, 20c.

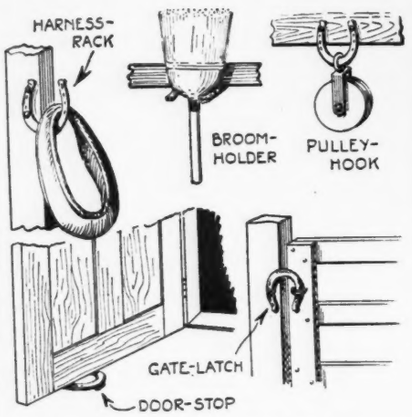
THE HOME WORKSHOP

Lo, the Lucky Horseshoe! Its Uses Are Many

WHY is the horseshoe a symbol of good luck? Perhaps it is because a discarded horseshoe is the most versatile piece of junk known to man.

Nailed along the rafters of the barn it makes an excellent hook for harness. Nailed in a horizontal position, it will hold three or four pitchforks. As a substitute step for a high wagon, it can't be beaten. When hung with the toe of the shoe down, it is often used as a gate-latch by merely hooking it over a bolt on the gate and running one side through a staple on the post.

Recently a horseshoe was used in an emergency as a splint for a broken arm,



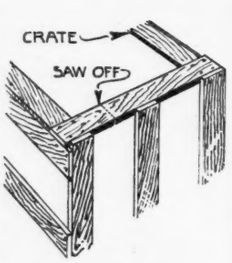
Five little-known uses for the old horseshoe

with more satisfactory results than might have been expected. On the farm, horseshoes are used often as clevises in attaching two machines together; they make excellent hooks on which to hang pulleys; a swing or hammock can be suspended readily from them.

The best and heaviest shoes are saved for the game of "horseshoes." A large one with high toe-calks is sometimes sandpapered and enameled for use as a doorstop. With a little ingenuity, a horseshoe may be made to serve in many emergencies, for its shape, strength, and weight make it one of the most valuable "by products" of the farm.

The Correct Way to Open Lock-Corner Crates

MANY railroad companies demand that all heavy objects, like machinery, furniture, etc., intended for shipment by rail, be packed in crates with interlocked corners, the type of which is shown in the illustration. The interlocking of the strips of wood at the corners greatly adds to the strength of the crate, but makes it very difficult to remove the framework at the point of destination. This difficulty may be overcome by sawing through the bars of the crate near the four corners on one side of the crate. That part can then be taken off without difficulty.



Use a saw to open a lock-corner crate

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The Larger Types are for heavy batteries, or where time is limited. Shipping Weights Complete with Ammeter & Battery Clips, 12 to 15 lbs. Send check for Prompt Express Shipment: or for Parcel Post Shipment add Postage and Insurance charges, or write us to forward C.O.D. Order Now, or Write for FREE Descriptive BOOSTER Bulletin No. 17. For GROUP Charging ask for Free ROTARY RECTIFIER Bulletin 17-B.
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THE HOME WORKSHOP

Electric Tester Quickly "Candles" Eggs

EGGS are, unfortunately, not always what they seem. An inspection of the shell gives no idea of the condition of the yolk. It is not difficult, however, to rig up an egg-tester that will reveal the hidden and inner truths.

Make a cardboard funnel with the small end just large enough to take the bulb end

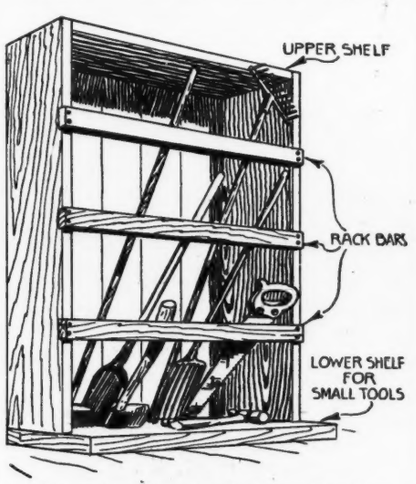
A cardboard funnel partially closed with a disk converts an electric flash-lamp into an efficient egg-tester

of an electric flash-lamp; the cylindrical type is the most convenient for the purpose. Close the large end of the funnel with a cardboard disk in which there is a hole just large enough to cradle the egg nicely.

White cardboard, which will reflect the light, should be used for the egg-holder. When an egg is put in place, it can be quickly "candled" merely by flashing on the light.—HOWARD GREENE.

Handled Tools Should Have This Special Rack

HEREWITH is shown an improved rack that has several retaining bars instead of one. Tools having long handles are placed inside the upper bar, intermediate behind the middle one, the



The awkward tools with long handles that are often left about for some one to stumble over should be kept in a rack

shorter ones below. As the bars are placed well away from the wall, there will be no interference of the various heads and handles in the different tiers, so that every tool will be instantly available.

2100 fine tools are described and illustrated in the new Starrett Catalog No. 22"W". Sent free on request. Write for copy.

Two generations of skilled machinists have learned to know Starrett Tools and to trust them.

Under the tuition of these men, thousands of apprentices are today learning for themselves the superior value in every Starrett Tool. No more conclusive evidence of quality could be asked than the marked preference for Starrett Tools shown by these men, to whose livelihood the selection of good tools is an essential matter.

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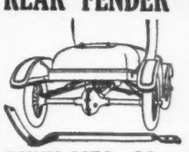
REAR FENDER BRACE FOR FORDS



Stop the squeak and rattle in your rear fenders with Dunn Braces. Prevent breakage. They look well. Only $1.00 per pair, at your dealers, or, mailed prepaid for that amount. Easily installed yourself. End your fender trouble. Send name and $1.00 NOW. Shipped day order received.

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Cold Pipe Bending Machines
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HOBART BROTHERS COMPANY, Box S17, Troy, Ohio

Indications Favor the Counter-User

You have to count most any product you make; why not count it *as* you make it and get the benefit of knowing what's doing?

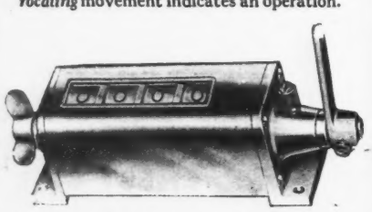
A Veeder Counter will register any shortcoming of your machine or slow-going of the operator, before the effect is seriously felt in reduced output.

You see every indication of how the work is going—and as sure as you do, the indications are: *More production!*—soon as you put on a

Veeder COUNTER

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable to experimental work. If run backward, the counter subtracts. Price $2.00. (*Cut 4/5 size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.

The Set-Back Rotary Ratchet Counter below is for the larger machines, such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



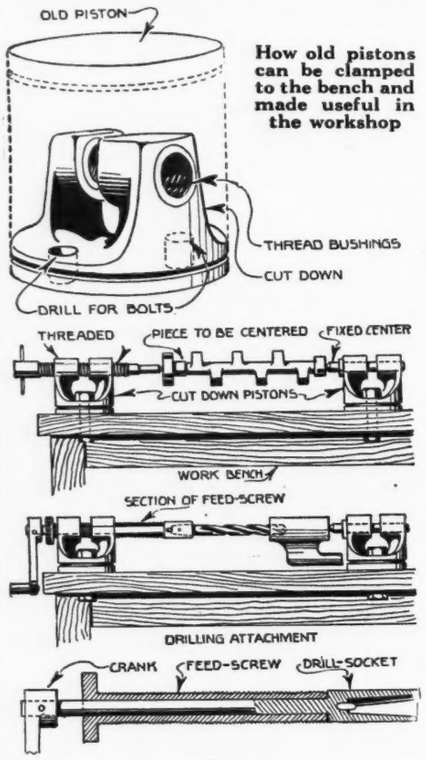
Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-Back Revolution Counter, to count revolutions of a shaft (large model like the above). $10.00 (list).

There's a Veeder exactly suitable for the type of machine you're interested in; write for free illustrated booklet.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

Pistons Become Serviceable Bench Centers

SERVICEABLE bench centers can be made of two pistons from an engine. The arrangement of these pistons is shown in the illustration. They are sawed down to leave only the wristpin bearings and permit of setting two bolts



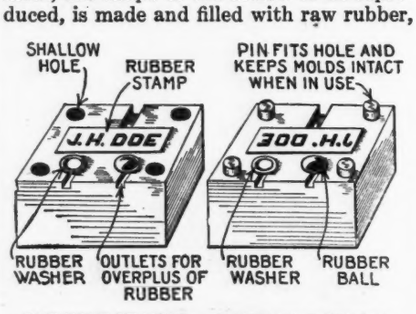
How old pistons can be clamped to the bench and made useful in the workshop

through the head of each for clamping them to the top of the workbench.

To one piston a fixed center is attached, while in the other is placed an adjustable center threaded into the wristpin bushings. These centers are of service in truing up parts or holding them while filing or fitting them. By fitting a screwed bearing with separate shaft, crank, and drill socket, jobs of drilling can be done in this fixture.

How Vulcanizing Molds Can Be Made at Home

RUBBER balls, rubber stamps, washers, stoppers, and other articles of rubber are easily made at home. A plaster of paris mold, the shape of the article to be reproduced, is made and filled with raw rubber,



How the two halves of a small vulcanizing form may be constructed

the whole being cooked until the rubber is as hard as desired. Cooking rubber, of course, is called vulcanizing.

The mold is in two parts and is easily made. Take a box of suitable size and fill it with well-mixed plaster of paris. Then press the pattern of the article to be reproduced halfway into the surface, smoothing off any excess plaster so that the plaster surface is flush with the edges of the box.

A few minutes after the plaster has set pull the plaster mold from the box. Fill the box again with plaster of paris, and superimpose the first plaster mold on the surface of the new one.

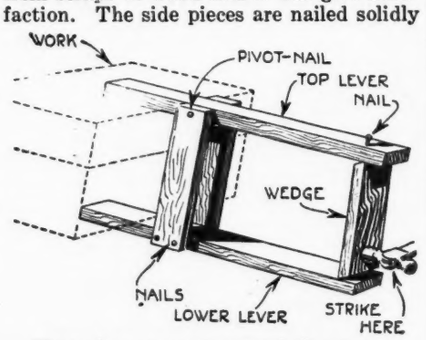
When the second half of the mold has set, the pattern should be removed and a groove cut to allow for expansion of the rubber. Fill the cavity full of raw rubber, clamp the two halves of the molds together, and bake in a slow oven for a few minutes. The exact time depends on the heat of the oven, the thickness of the rubber, and the hardness desired, so that it is impossible to give more exact directions, although on first trial, ten minutes' cooking might be tried. If this is not enough, put the article back and cook it some more.

In order that the two halves of the mold should register properly, it is advisable to use two nails for dowels at opposite corners. These nails should be imbedded in the first mold, heads down.

If wood patterns are used, they should be soaked well in water, otherwise they will swell when brought in contact with the plaster and will split the molds. Flat articles, such as washers, rubber stamps, stoppers, etc., may be set flush with the top of the first mold, the second mold merely acting as a cover. Rubber balls, however, and other articles, will have to be molded half in the upper and half in the lower. No article can be molded if its pattern is of such a shape that it cannot be withdrawn from the mold. The molds should always be wetted before using in order to prevent burning of the rubber.—R. F. CLARK.

An Improvised Clamp for the Home Carpenter's Use

AN improvised clamp like that shown in the illustration may be made easily from scraps of wood and it will give satisfaction. The side pieces are nailed solidly



If you have no carpenters' clamp, you may improvise one as shown here

to the lower lever, while at the top only one nail is driven from each side. This permits the upper lever to swing on a pivot. A piece of wood is driven between the longer ends of the levers. As the longer ends of the levers spread apart, the shorter ends close, tightly clamping the work. A long nail may be driven through the long end of the swinging lever. This will act as a stop to prevent the wedge piece from moving when it is driven into place.

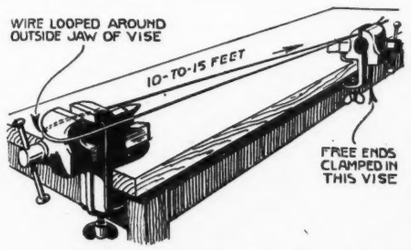
A clamp such as this will be just as satisfactory as a purchased one and will cost but a few minutes' time to make in your own workshop.—R. H. KASPER.

THE HOME WORKSHOP

Straightening Iron Core-Wire with Two Vises

IF the amateur orders a roll of core wire for induction coils, it usually comes all kinked. Straightening it by rolling or hammering is a long task.

If two vises are available, they may be placed at right angles to each other about



Opening the jaw of the lower vise stretches the wire and straightens out kinks without the labor of rolling and hammering

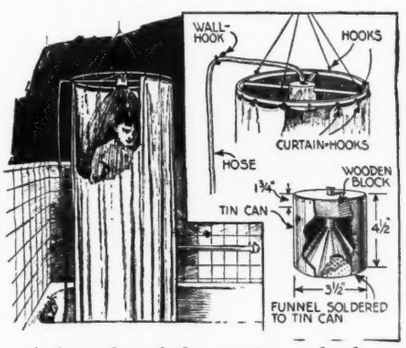
10 or 15 ft. apart, and the wire doubled over the jaws of one and the free ends clamped in the jaws of the other.

Opening the first vise stretches the wire and quickly takes out every kink, leaving the wire perfectly straight, after which it may be cut into the desired lengths, bundled, and annealed.—V. H. TODD.

Shower-Bath Made with Copper Funnel

THE home worker who is handy with a soldering-iron will have no difficulty in constructing a shower-bath attachment. The framework supporting the device illustrated was made from a large, old-fashioned baby-carriage wheel 26 in. in diameter, the spokes of which had been removed.

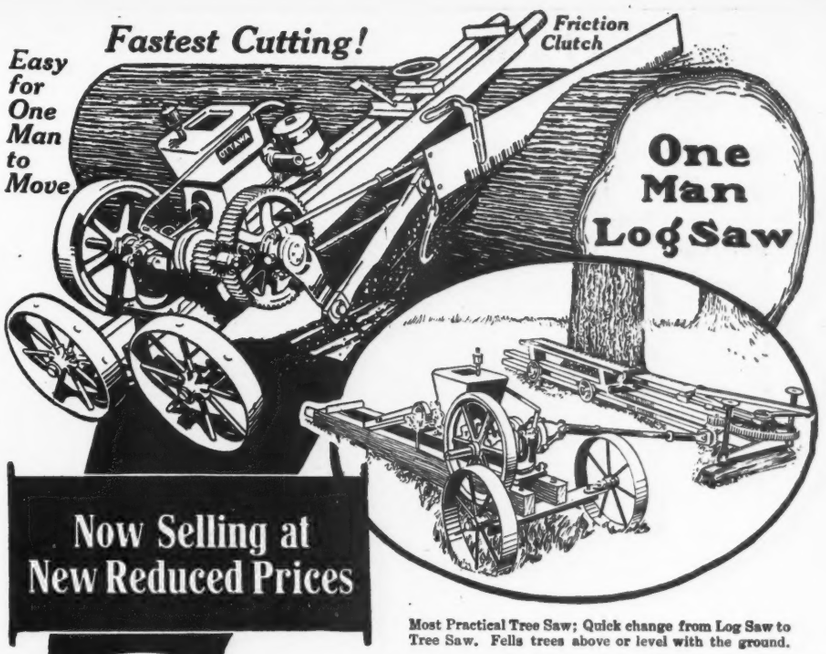
The base of the spraying apparatus was a copper funnel. A piece of copper was cut the right size to close the mouth of the



A funnel, a baby-carriage wheel, a rubber tube, and a few odds and ends form this ingenious shower-bath

funnel and, after fine holes had been punched in it, was soldered in place. A tin can was then chosen of such a size that the mouth of the funnel would just fit inside, and the two were soldered together, around the bottom.

The top of the can was closed with a piece of pine through the center of which a hole had been bored to permit the spout of the funnel to project and into which the four spokes of the "wheel" were fitted. A rubber tube was used to connect the faucet and the funnel and a curtain was hung from the frame. The whole device was enamelled white to harmonize with the bathroom fittings.—HARRY VOELKER.



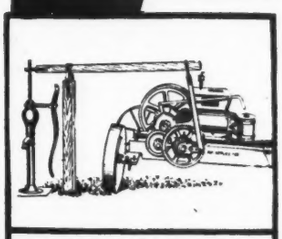
Most Practical Tree Saw; Quick change from Log Saw to Tree Saw. Fells trees above or level with the ground.

Quick change to Branch Saw. Sold with or without Log Saw.

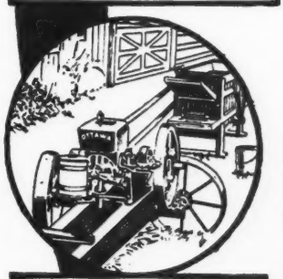
Cuts 36 Cords of Wood a Day With His OTTAWA! Read this Letter:

"I am glad to tell you that the OTTAWA Log Saw is all you say. I saw 36 cords of wood a day with the OTTAWA and never have any trouble. I have started sawing again this week. FELIX MARTINS, Withee, Wis."

Coal is high in price. There is a big demand for wood as fuel. Many OTTAWA owners report splendid profits sawing for neighbors, and selling wood in towns and cities. T. O. Shurson of Eagle Grove, Ia., writes:—**"I made $255.25 extra in two months."** Others claim larger profits.



The OTTAWA Pumping Attachment at Lowest Cost.



The OTTAWA will run your Pea Huller and other machinery.

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4 H-P. Motor LOG SAW

Friction Clutch starts and stops saw while engine runs. Power Force Feed makes the OTTAWA saw the human way, easiest, quickest, safest. Magneto Ignition—no batteries ever needed. 4 H-P. Motor; ample power for sawing logs, falling trees, buzzing up branches and for belt work. Big opportunities and splendid profits for OTTAWA owners now.

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Note the renewable cutting edges. There's the reason why Neverslip Pliers will outcut and outlast any plier made.

Here's a Pair of Pliers you *can't* wear out

JUST pick up a pair of Neverslip Pliers—heft them—now look at the blades. Here's a pair of pliers you can't wear out.

The secret of Neverslips' long life is just this: When other pliers are made, their cutting edges are made at the same time, from the same piece of metal. That's why they cannot have high carbon crucible steel edges like Neverslips. Moreover, as the Neverslip cutting edges are made separate it means they are renewable. You can cut nails, heavy wire, soft metal or insulation cleanly and quickly with Neverslip Pliers.

Buy a pair of Neverslip Pliers and you've made a life-long friend. For Neverslips will outlast and outcut any plier made. And when it comes down to a matter of price, Neverslip Pliers cost no more than the short-lived pliers you've been buying only to throw away as soon as they become worn.

Your plain sense of economy ought to tell you that it's worth a special trip to your hardware store for a pair of Neverslip Pliers. If your dealer hasn't them in stock, send us his name and we will see that you are supplied.

THE NEVERSLIP WORKS

New Brunswick - New Jersey

NEVERSLIP

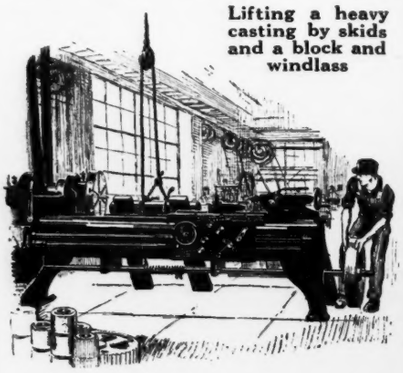
side cutting pliers

Neverslips are furnished in 6—7 and 8 inch sizes

A Quickly Rigged Hoisting Kink for the Shop

IF you were all alone in the shop and had to get a heavy casting—too heavy to lift with your hands—on a lathe, you would look around for some mechanical help.

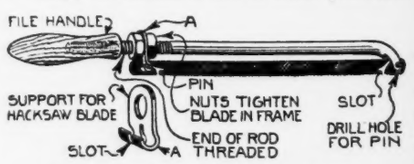
The combination of a single block, shaft-and-pulley windlass, and a pair of skids enabled one man to lift a three-hundred-pound casting on to the lathe with ease.



Lifting a heavy casting by skids and a block and windlass

Special Saw-Frame Constructed for Restricted Space

HACKSAW frames are frequently too large to permit of use in close quarters.



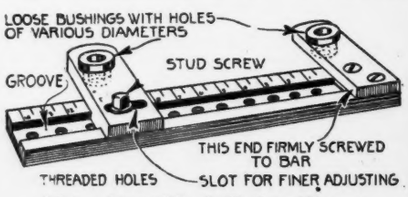
This improvised hacksaw frame will go into places where there is no room to use a full-size tool

The frame shown is made of a piece of cold-rolled steel fitted with a file handle, and slotted at one end for the insertion of the blade. The opposite end of the blade is held by support secured by nuts threaded on the end of the rod.

Adjustable Drill-Jig Suitable for the Small Shop

A JIG that will drill holes of different diameters and spaced at different distances is shown here.

Cut a groove in a block of steel as shown; permanently fasten the bushing-plate to the end of this block, then make a sliding block or plate as shown.



This adjustable drill-jig will save making a special jig

One end of the main block is graduated in inches and parts of an inch, while the slotted hole allows for fine adjustment.

This device allows the drilling of holes any distance apart within the limits of the main block, and as the bushings shown are removable, these can be changed whenever such a change is desired.—J. H. MOORE.